SD11
.A573
#202

United States
Department of
Agriculture

Forest
Service

North Central
Research Station

Resource Bulletin
NC-202

BIA Forest Lands of North and South Dakota, 1996

David E. Haugen and Mark H. Hansen

North Central Research Station
Forest Service—U.S. Department of Agriculture
1992 Folwell Avenue
St. Paul, Minnesota 55108
2002
www.ncrs.fs.fed.us

This report includes the most commonly used U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis (FIA) statistics. Additional forest resource data can be obtained through FIA staff, an FIA CD-ROM, or through a table generator on the North Central Research Station's Internet page. Persons requesting additional information that requires FIA staff time are expected to pay the retrieval costs. Requests for information may be directed to:

Program Manager
Forest Inventory and Analysis
North Central Research Station
1992 Folwell Avenue
St. Paul, MN 55108
Phone: (651) 649-5139
FAX: (651) 649-5285

Bureau of Indian Affairs, USDI Billings Area Office
316 North 26th Street
Billings, MT 59101
Phone: (406) 247-7943
FAX: (406) 247-7976

FOREWORD

Forest Inventory and Analysis (FIA) is a continuing endeavor as mandated by the Renewable Resources Research Act of 1978. The objective of FIA is to periodically inventory the Nation's forest resources. Up-to-date resource information is essential to frame forest policies and programs. U.S. Department of Agriculture, Forest Service regional research stations are responsible for conducting these inventories and publishing summary reports for individual States. The North Central Research Station is responsible for inventory and analysis in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.

Data used in this report were collected during the third North Dakota forest inventory, begun in September 1994 and completed in November 1994, and the fourth South Dakota forest inventory, begun in 1995 and completed in the spring of 1996. The reported statistics are estimates. Users of these data are cautioned to consult the table of sampling errors and the inventory methods section of the appendix. Fieldwork for these inventories was expedited through the cooperation and assistance of the Bureau of Indian Affairs, U.S. Department of the Interior.

The North and South Dakota inventories were directed by Neal Kingsley (retired), FIA Program Manager, North Central Research Station, St. Paul, Minnesota. Robert Sienko, Bureau of Indian Affairs, Billings, Montana, Area Office, coordinated the BIA's participation.

St. Paul FIA office staff at the time were: Roger Audette, Gary Brand, Beth Collins, Barb Fuller, Dan Goodman, Dale Gormanson, Dan Groen, Ron Hackett, Mark Hansen, David Haugen, Doug Hecker, Jennifer Iole, Barb Johnson, Mike Johnson, Neal Kingsley, Barb Knight, Leo Larkin, Earl Leatherberry, Joel Lemberg, Troy Lindgren, Doug Magee, Dennis May, Pat Miles, Jerry Ostrom, Ron Piva, Gerhard Raile, Mary Jo Resendez, Thomas Schmidt, Jay Solomakos, Dan Wendt, and Suzann Willhite.

FIA field crew members were: John Benaszeski, Avery Beyer, Nathan Goodrich, Gary Inhelder, Lisa McDonald, Peter Koehler, Keith Magnusson, Mark Majewsky, Timothy Miller, Daniel Nelson, Wilfred Ortiz, Paul Perdew, Daniel Sherrill, Gary Stachowicz, Kristen Weber, and Chris Yonkers.

CONTENTS

	Page
Highlights	**1**
Forest Area	2
Forest Type Composition	2
Oak-Hickory	3
Elm-Ash-Locust	3
Aspen-Birch	3
Elm-Ash-Cottonwood	3
Maple-Beech-Birch	4
Ponderosa Pine	4
Stand-Size Classes	4
Productivity of Timberland	5
Stocking May Hold the Key to Improved Productivity on BIA Timberlands	5
Number of Trees—North Dakota BIA	6
Number of trees—South Dakota BIA	6
Timberland Volume	7
Growing-Stock Volume	7
Volume Per Acre	8
Sawtimber	8
Timber Quality	9
Growth	10
Growing-Stock Growth	10
Sawtimber Growth	10
Mortality	11
Mortality in Growing Stock	11
Mortality in Sawtimber	11
Removals	11

Appendix 12

Reliability of the Survey 12

Comparing the 1994 North Dakota and 1996 South Dakota Inventories with the 1980 Inventories in These Two States 13

Survey Procedures 13

Statistical Design 14

Sample Based on the Remeasurement of the 1980 NCFIA Inventory 14

1980 NCFIA Inventory Aerial Photo Plots (Phase 1) 14

1980 NCFIA Inventory Ground Plots (Phase 2) 14

Remeasurement of the 1980 NCFIA Inventory 15

Sample Based on the NRCS-NRI 16

Combined Estimate Based on the Two Independent Inventories 17

Field Measurements: 1980 Inventory Plot Design 17

Field Measurements: 1994-1996 Inventory Plot Design 18

New Inventory Plots 18

Old Inventory Plots 18

Computation of Estimates 20

Area 20

Volume 20

Growth and Mortality 20

Average Annual Removals 20

Tree and Log Grades 21

Metric Equivalents 24

Tree Species Groups in North and South Dakota 25

Definition of Terms 26

Literature Cited 33

Table Titles 34

Tables 36

BIA Forest Lands of North and South Dakota, 1996

David E. Haugen and Mark H. Hansen

HIGHLIGHTS

- BIA forest lands in North Dakota and South Dakota amounted to 146.1 thousand acres of forest land, and 131.3 thousand acres of this land were classified as timberland.
- In addition to the forest land area, BIA lands have 56.9 thousand acres of nonforest land with trees. Nonforest land with trees includes wooded strips, farm and field windbreaks, wooded pastures, and abandoned cropland.
- Aspen-birch is the most extensive forest type found on North Dakota BIA timberlands, accounting for more than 57 percent, or 22.4 thousand acres of timberland. Ponderosa pine is the most extensive forest type found on South Dakota BIA timberlands, accounting for more than 44 percent, or 41.3 thousand acres of timberland.
- Even with the prevalence of adverse growing conditions in North and South Dakota, over a fifth of BIA timberlands are capable of growing more than 50 cubic feet of wood per acre per year.
- Growing-stock volume on North Dakota BIA timberlands was 21 million cubic feet in 1994 and represented 6 percent of the State's total volume. Growing-stock volume on South Dakota BIA timberlands was 62.6 million cubic feet in 1996 and represented 14 percent of the State's total volume outside of the Black Hills National Forest.
- Sawtimber volume in 1994 stood at 30.1 million board feet on North Dakota BIA timberlands and at 264.5 million board feet on South Dakota BIA timberlands in 1996.
- Eighty-six percent of the total sawtimber volume found on North Dakota BIA timberlands came from aspen, bur oak, and balsam poplar species groups. On South Dakota timberlands, 88 percent of the total sawtimber volume came from ponderosa pine and cottonwood species groups.
- An average of 1.7 million cubic feet of net growth of growing stock was added to BIA timberlands per year between 1980 and 1995. In North Dakota, this translates to an estimated 17.6 cubic feet per acre of average annual net growth on BIA timberlands. On South Dakota BIA timberlands, annual net growth averaged 16.5 cubic feet per acre per year.

About the Authors:

David E. Haugen is a Forester and **Mark H. Hansen** is a Research Forester in the Forest Inventory and Analysis Program at the North Central Research Station, St. Paul, Minnesota.

Note.—The forest land area in this report represents areas identified by the Bureau of Indian Affairs (BIA) as "Tribal Trust Land" within the boundaries of reservations in the States of North and South Dakota. Tribal Trust Lands outside of reservation boundaries, individually owned trust lands, and government-owned lands were not included in this report. This report contains information useful for identifying forestry related trends on trust lands. Professionals with the Branch of Forest Resource Planning (BOFRP) within the Forestry Division of the BIA can use this information in natural resource planning.

- On a per acre basis, growing-stock mortality averaged 8.8 cubic feet per acre per year from 1980 to 1995 on BIA timberlands. Thus, nearly 41 percent of the annual gross growth of growing stock was lost to mortality.

- Average annual removals of growing stock between 1980 and 1995 was 1.1 cubic feet per acre per year.

- BIA forests provide food, cover, and protection for a vast array of wildlife species from elk to turkey. In addition, they improve water quality and control streambank erosion and sedimentation.

FOREST AREA

In 1994, BIA lands in North Dakota were estimated at 246 thousand acres, and 48 thousand acres or 20 percent were forested. In 1996, South Dakota BIA lands were estimated at 2.6 million acres of which 99 thousand acres or 4 percent were forested. Total area of timberland on BIA land was estimated at 39 thousand acres in North Dakota and 93 thousand acres in South Dakota. Woodland area on BIA lands was estimated at 9 thousand acres for North Dakota and 6 thousand acres for South Dakota.

Land classified as nonforest with trees was estimated at 5 thousand acres on BIA lands in North Dakota in 1994 and at 52 thousand acres on BIA lands in South Dakota in 1996. Examples of nonforest land with trees would include windbreaks, wooded strips, improved pastures with trees, and wood pastures. Typically, nonforest land with trees offers few possibilities for commercial use. However, such land does offer many benefits including soil erosion control (improved water quality), rural buildings and land protection (improved quality of life), shade for livestock, and shelter and food for wildlife.

FOREST TYPE COMPOSITION

Hardwood forest types dominate the forest landscape on North Dakota BIA timberlands. In fact, only three forest types were recorded during the inventory on BIA timberlands in North Dakota: aspen-birch, oak-hickory, and elm-ash-locust (fig. 1). South Dakota BIA timberlands have a mix of softwood and hardwood forest types (fig. 2). Softwood forest types found during the 1996 inventory were ponderosa pine and Rocky Mountain juniper. Hardwood forest types included oak-hickory, elm-ash-locust, elm-ash-cottonwood, and maple-beech-birch.

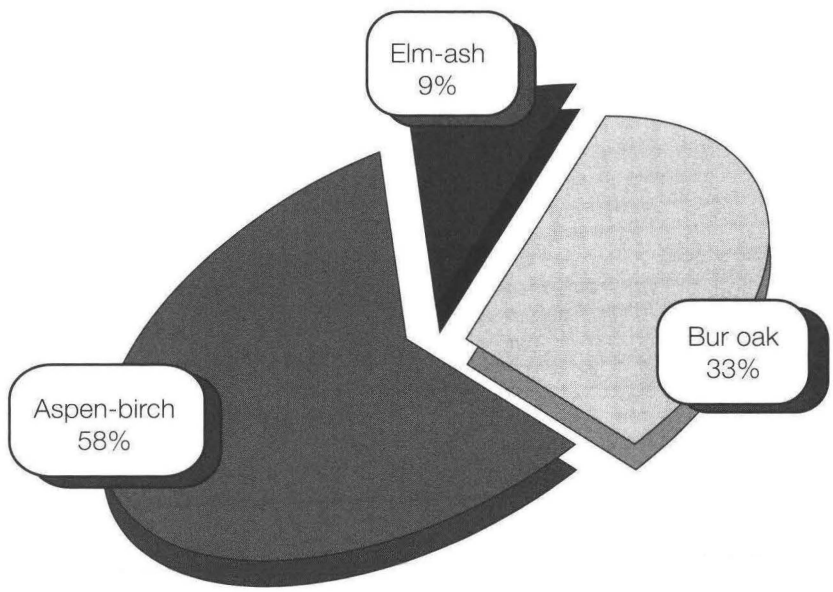


Figure 1.—*Percent of area by forest type, North Dakota BIA, 1994.*

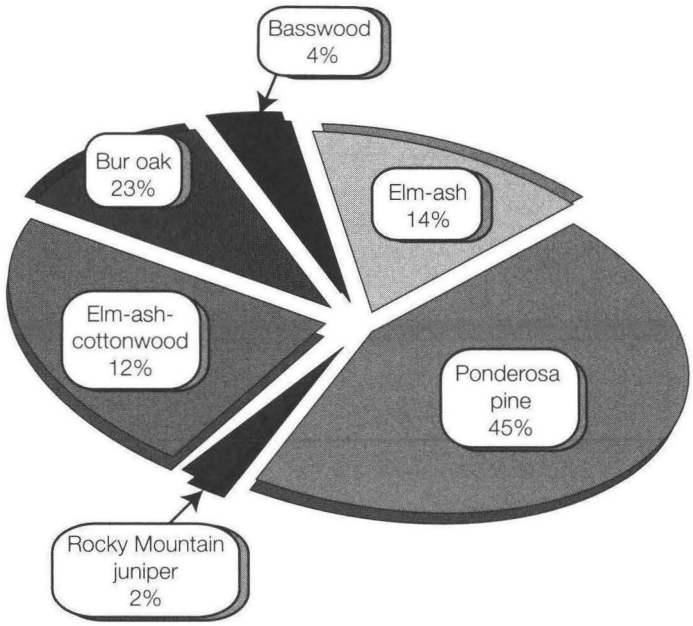


Figure 2.—*Percent of area by forest type, South Dakota BIA, 1996.*

Oak-Hickory

The oak-hickory forest type occupied 12.8 thousand acres or 33 percent of the total BIA timberlands in North Dakota and 21.2 thousand acres or 23 percent of the total BIA timberlands in South Dakota. Because bur oak is the only native oak species found in North and South Dakota, the local type is called bur oak. Species commonly associated with the bur oak forest type in North and South Dakota are basswood and green ash.

Elm-Ash-Locust

In the most recent inventory, the elm-ash-locust forest type occupied 3.6 thousand acres or 9 percent of the total BIA timberlands in North Dakota and 12.8 thousand acres or 14 percent of total BIA timberlands in South Dakota. The local forest type is called elm-ash, an upland forest type dominated by American elm and green ash.

Aspen-Birch

The aspen-birch forest type occupied 22.4 thousand acres or 58 percent of the total BIA timberlands in North Dakota. The entire State of North Dakota has 117.8 thousand acres of aspen-birch forest type, which means that 19 percent of all aspen-birch forest land in the entire State is found on North Dakota BIA timberlands.

Elm-Ash-Cottonwood

The elm-ash-cottonwood forest type, a lowland forest type, occupied 11.2 thousand acres or 12 percent of the total BIA timberlands in South Dakota. The elm-ash-cottonwood forest type can be broken down into three local forest type groups, which are cottonwood (6.7 thousand acres), elm-ash-cottonwood (2.4 thousand acres), and willow (2.1 thousand acres). A major forestry concern in the Plains States is the lack of cottonwood regeneration. Two major factors contributing to this problem are the construction of flood control dams on major rivers and streams and the grazing of livestock in riparian areas. Cottonwood seeds require a nearly bare mineral soil seedbed to germinate. Frequent flooding along the streambanks helps prepare a suitable seedbed for germination. Reduced periodic flooding has decreased the availability of bare mineral soils for cottonwood seeds to germinate (Haugen *et al.* 1999).

Maple-Beech-Birch

In 1996, the maple-basswood forest type (local forest type) occupied 3.9 thousand acres or 4 percent of BIA timberland in South Dakota. The entire State of South Dakota has only 5 thousand acres of this type, which means that 78 percent of this particular forest type is found on BIA timberlands.

Ponderosa Pine

In 1996, the ponderosa pine forest type occupied 41.3 thousand acres or 45 percent of BIA timberland in South Dakota. Much of this forest type was found on the Pine Ridge Reservation.

STAND-SIZE CLASSES

Stand-size class is a classification of stocked forest land based on the size class of live trees on the area: sawtimber, poletimber, and sapling and seedlings (figs. 3 and 4).

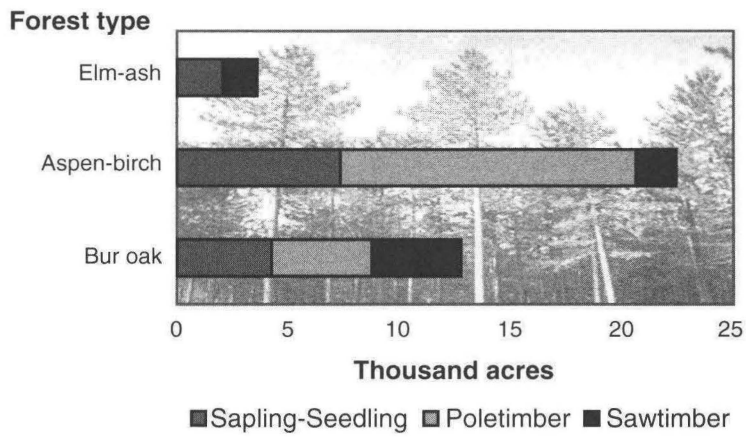


Figure 3.—*Area of timberland by forest type group/local type and stand-size class, North Dakota BIA, 1994.*

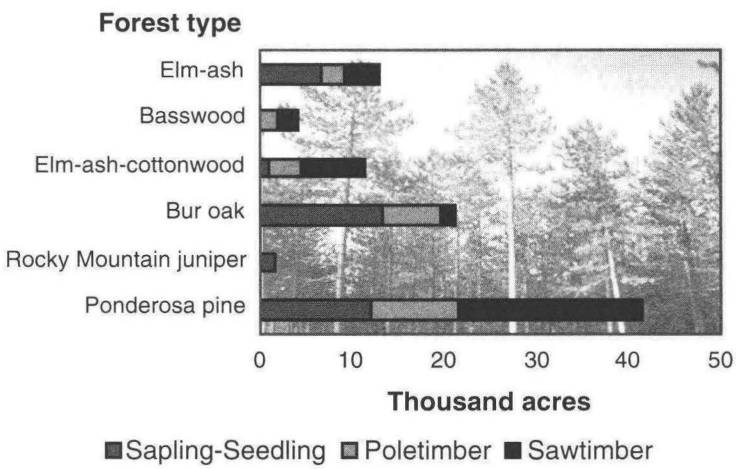


Figure 4.—*Area of timberland by forest type group/local type and stand-size class, South Dakota BIA, 1996.*

PRODUCTIVITY OF TIMBERLAND

BIA forest lands are productive: 80 percent of all BIA forest lands in North Dakota and 94 percent of all BIA forest lands in South Dakota have the potential to annually produce 20 or more cubic feet of wood per acre per year. The forest land area can be divided into two major land-use classes: timberland and woodland. North Dakota BIA forest land consists of 38.8 thousand acres of timberland and 8.8 thousand acres of woodland. South Dakota BIA forest land consists of 92.5 thousand acres of timberland and 6 thousand acres of woodland.

On BIA timberlands, potential productivity class is used to evaluate timberland site quality as related to potential timber production. Potential productivity is expressed in cubic feet of net growth per acre per year on a given site. Productivity on BIA timberlands in North and South Dakota is lower than in other regions due in part to extreme weather conditions, including drought, strong winds, and widely varying seasonal temperatures. Only 4 percent of BIA timberland in North Dakota has the potential to produce more than 85 cubic feet per acre per year of growth and less than 1 percent of BIA timberland in South Dakota can produce this much. Another 37 percent of the BIA timberland in North Dakota has the potential to produce between 50 and 84 cubic feet per acre per year of growth, compared to an average of 22 percent for the entire State. Only 14 percent of South Dakota BIA timberland has the potential to produce between 50 and 84 cubic feet per acre per year. Most timberland, 86 percent on South Dakota BIA land and 59 percent on North Dakota BIA land, has the potential to produce less than 50 cubic feet of growth per acre per year.

STOCKING MAY HOLD THE KEY TO IMPROVED PRODUCTIVITY ON BIA TIMBERLANDS

Stocking is an estimate of occupancy of a given site, usually measured by basal area or number of live trees required to fully utilize the growth potential of the land. In North Dakota, 40 percent of BIA timberland area is either nonstocked or poorly stocked (fig. 5), while in South Dakota, 75 percent of BIA timberland area is either nonstocked or poorly stocked (fig. 6). In comparison, 53 percent of total timberland area in North Dakota and 58 percent in South Dakota is poorly stocked or nonstocked. Another 30 percent of the BIA timberland area in North Dakota and 20 percent of BIA timberland area in South Dakota is moderately stocked. If stocking is increased even to moderate stocking levels on poor sites, growth will increase and the potential of timberland to grow and hold more wood fiber should be realized.

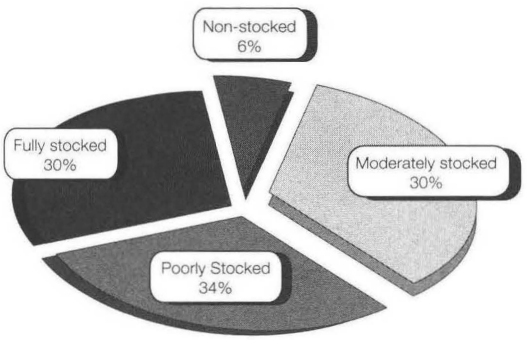


Figure 5.—*Percent of timberland by stocking class of growing-stock trees, North Dakota BIA, 1994.*

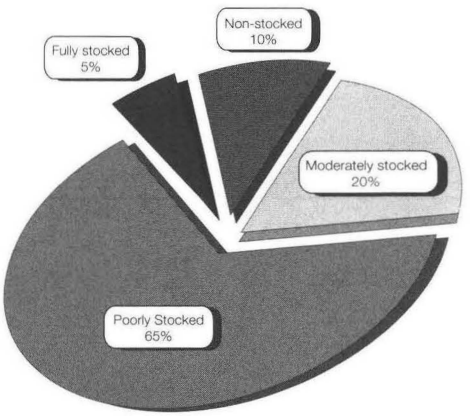


Figure 6.—*Percent of timberland by stocking class of growing-stock trees, South Dakota BIA, 1996.*

NUMBER OF TREES—NORTH DAKOTA BIA

In 1994, an estimated 22 million live trees 1 inch or greater d.b.h. were growing on 38.8 thousand acres of North Dakota BIA timberlands, an average of 568 trees per acre. Aspen, green ash, and bur oak were the dominant species with 39, 19, and 16 percent of the total number of live trees, respectively (fig. 7). Of the total number of live trees, growing-stock trees (a live tree of commercial species that meets specified standards of size, quality, and merchantability) accounted for an estimated 17 million trees, or 77 percent of all live trees. Noncommercial tree species, which include eastern hophornbeam (ironwood), wild plum, and peachleaf willow, accounted for 3 million or 14 percent of all live trees.

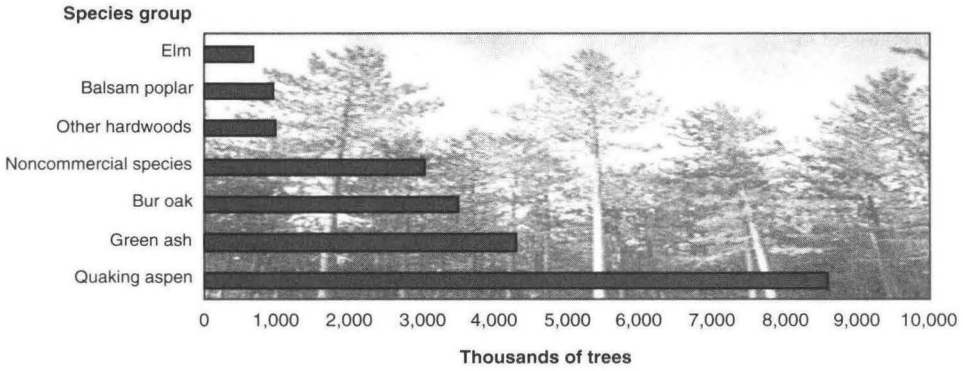


Figure 7.—*Number of all live trees on timberland by species group, North Dakota BIA, 1994.*

NUMBER OF TREES—SOUTH DAKOTA BIA

In 1996, an estimated 28 million live trees 1 inch or greater d.b.h. were growing on 92.5 thousand acres of South Dakota BIA timberlands, an average of 298 trees per acre. Ponderosa pine, green ash, and bur oak were the dominant species with 43, 12, and 11 percent of the total number of live trees, respectively (fig. 8). Of the total number of live trees, growing-stock trees accounted for an estimated 20 million trees, or 72 percent of all live trees. Noncommercial tree species, which include apple, wild plum, and peachleaf willow, accounted for 4 million, or 14 percent of all live trees.

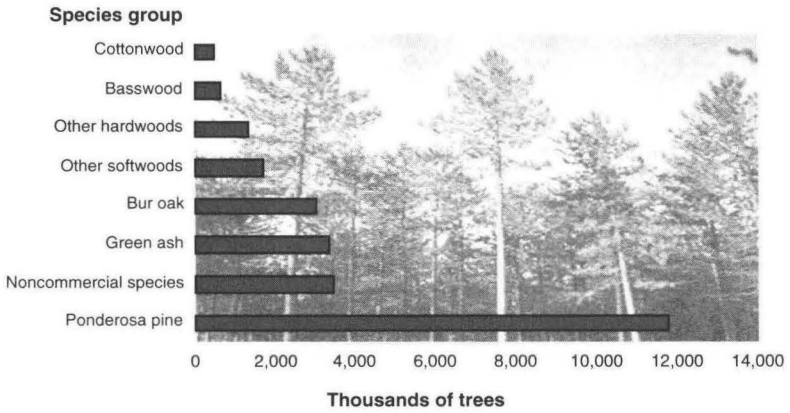


Figure 8.—*Number of all live trees on timberland by species group, South Dakota BIA, 1996.*

TIMBERLAND VOLUME

Growing-Stock Volume

Growing-stock volume was estimated at 21 million cubic feet on North Dakota BIA timberland and at 63 million cubic feet on South Dakota BIA timberland. On North Dakota BIA timberland, 90 percent of all growing-stock volume was contained in three species: quaking aspen, bur oak, and balsam poplar (fig. 9). On South Dakota BIA timberland, more than 79 percent of all growing-stock volume was contained in two species: ponderosa pine and cottonwood (fig. 10).

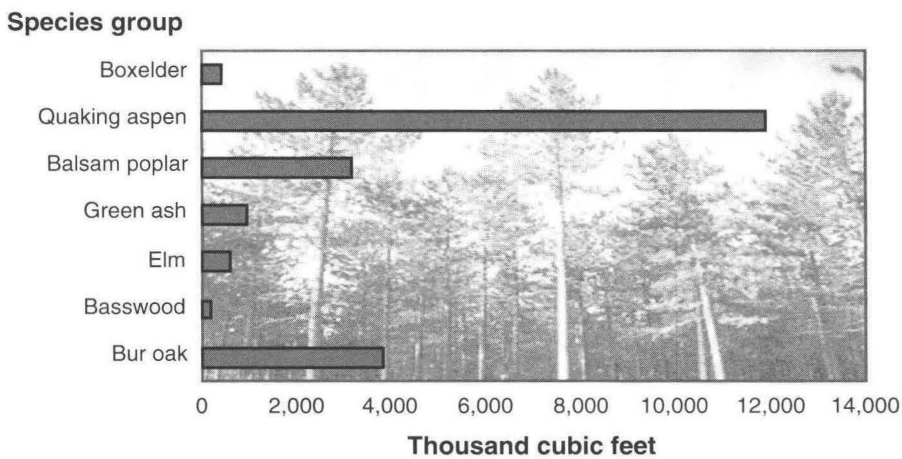


Figure 9.—*Net volume of growing stock on timberland by species group, North Dakota BIA, 1994.*

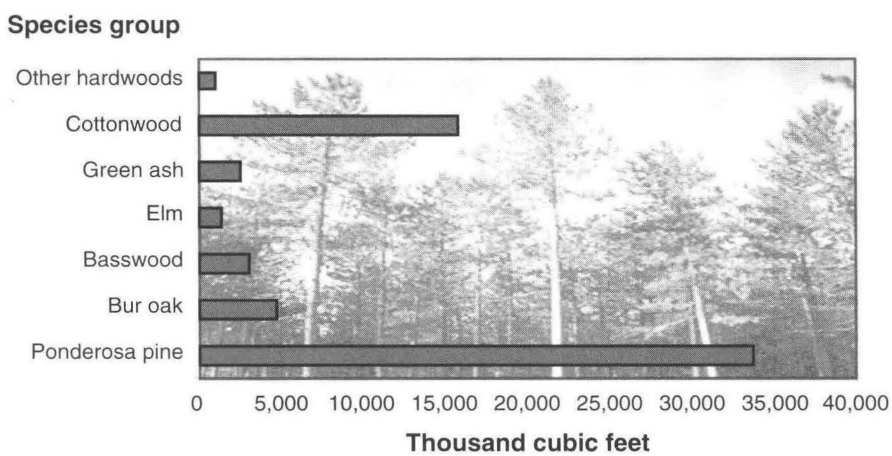


Figure 10.—*Net volume of growing stock on timberland by species group, South Dakota BIA, 1996.*

Volume Per Acre

Growing-stock volume per acre averaged 542 cubic feet on North Dakota BIA timberland, and 678 cubic feet on South Dakota BIA timberland. The aspen-birch forest type had the highest average for growing-stock volume per acre in North Dakota BIA in 1994 with 678 cubic feet per acre. On South Dakota BIA timberland, the cottonwood forest type had the highest average for growing-stock volume per acre with 1,140 cubic feet per acre. Other forest types with above average volume per acre on South Dakota BIA timberland were basswood (925 cubic feet per acre), elm-ash (914 cubic feet per acre), and elm-ash-cottonwood (707 cubic feet per acre). The willow forest type had the lowest per acre volume with 158 cubic feet per acre.

Sawtimber

Sawtimber volume was estimated at 30 million board feet on North Dakota BIA timberlands and at 234 million board feet on South Dakota BIA timberlands. Quaking aspen, bur oak, and balsam poplar represented 86 percent of the total sawtimber volume on North Dakota BIA timberlands (fig. 11). On South Dakota BIA timberlands, 88 percent of the total sawtimber volume came from two species: ponderosa pine and cottonwood (fig. 12).

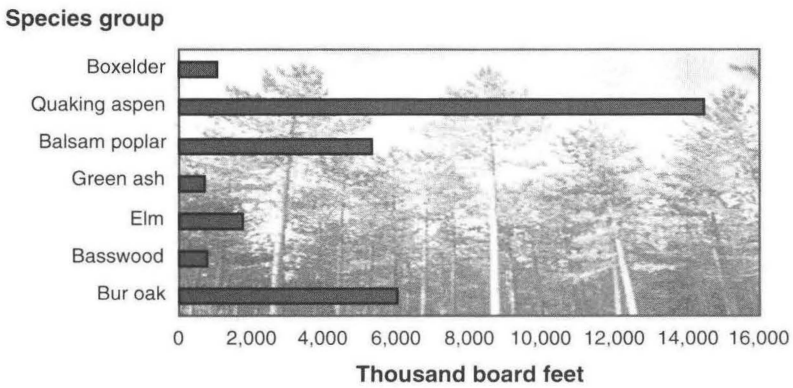
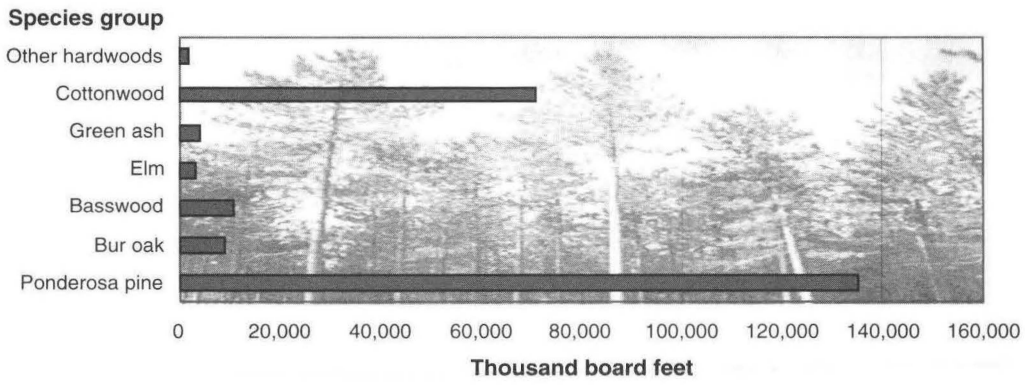


Figure 11.—*Net volume of sawtimber on timberland by species group, North Dakota BIA, 1994.*

Figure 12.—*Net volume of sawtimber on timberland by species group, South Dakota BIA, 1996.*



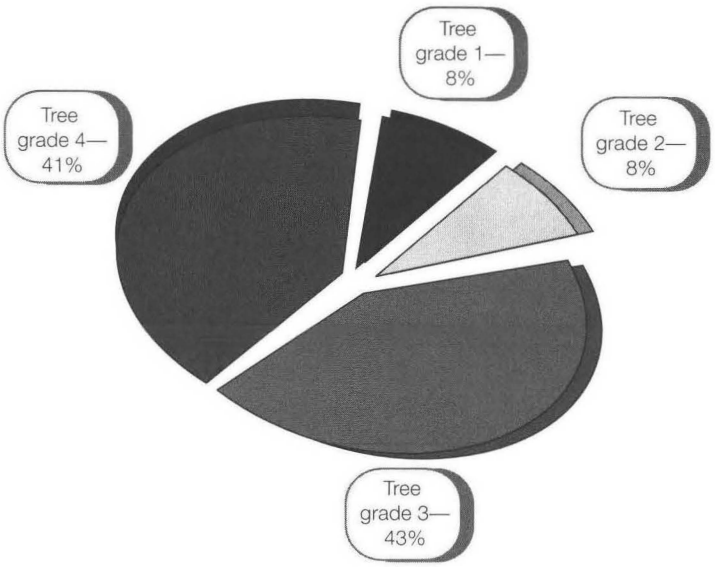


Figure 13.—*Quality of sawtimber by tree grade, North Dakota BIA, 1994.*

TIMBER QUALITY

As a measure of timber quality, field crews assigned log grades to softwood sawtimber trees and they assigned tree grades to hardwood sawtimber trees. In the Dakotas, the most critical factor in determining grade is the d.b.h. of the tree. On North Dakota BIA timberlands, 84 percent of the hardwood sawtimber was given a tree grade of 3 or poorer (fig. 13). The bur oak species had more than 81 percent of its volume in sawtimber less than 15 inches d.b.h. and 92 percent of its volume in grades 3 or poorer. On South Dakota BIA timberlands, ponderosa pine (softwood species) had 96 percent of its sawtimber volume in log grade 3; hardwood species had 39 percent of their sawtimber volume in tree grades 3 or poorer. Combined, all softwood and hardwood tree species in South Dakota BIA had 72 percent of their sawtimber volume in grades 3 or poorer (fig. 14). Three species—cottonwood, bur oak, and basswood—accounted for 61 percent of the sawtimber volume in tree grades 1 and 2; cottonwood accounted for 86 percent of the total volume in tree grades 1 and 2.

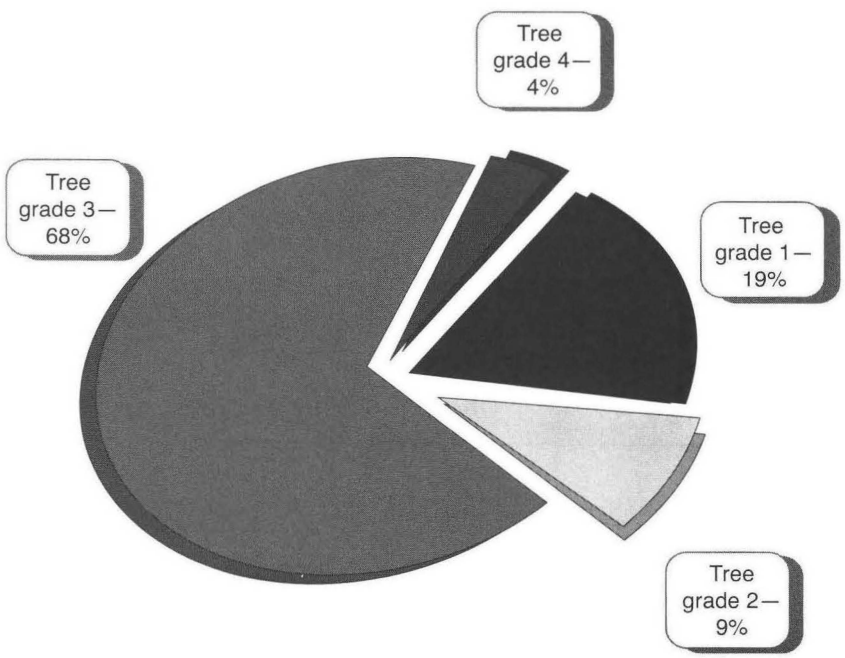


Figure 14.—*Quality of sawtimber by tree grade, South Dakota BIA, 1996.*

GROWTH

Growing-Stock Growth

An average of 1.7 million cubic feet of net growth of growing stock was added to BIA timberlands per year between 1980 and 1995 (fig. 15). In North Dakota, this translates into an estimated 17.6 cubic feet per acre of average annual net growth on BIA timberlands. The average annual growth rate on North Dakota BIA timberland is about 3 percent of the total growing-stock inventory. The aspen-birch forest type on North Dakota BIA timberlands accounted for 87 percent of the average net growth between 1980 and 1993. On South Dakota BIA timberlands, average annual net growth per acre is estimated at 10.5 cubic feet per year. The average annual growth rate on these lands is about 2 percent of the total growing-stock inventory. The ponderosa pine forest type accounted for 46 percent of the average annual net growth between 1980 and 1995.

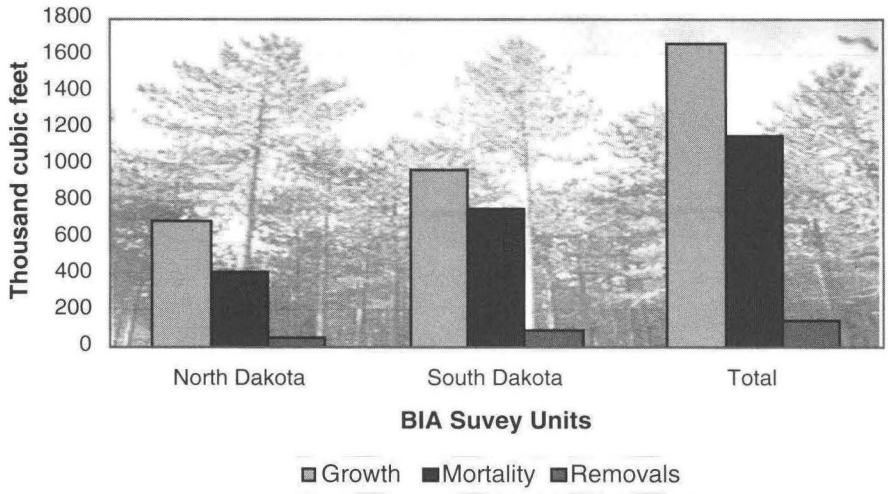


Figure 15.—*Average annual net growth, mortality, removals of growing stock on timberlands, North Dakota BIA, 1980-1993, and South Dakota BIA, 1980-1995.*

Sawtimber Growth

The average annual net growth of sawtimber between 1980 and 1995 was estimated at 850 thousand board feet for BIA timberlands in North Dakota and 3.0 million board feet on BIA timberlands in South Dakota per year (fig. 16). This averages out to be 22 board feet per acre per year of growth on North Dakota BIA timberland and 33 board feet per acre per year of growth on South Dakota BIA timberland. An estimated 98 percent of the average annual net growth of sawtimber came from the aspen-birch forest type on BIA timberlands in North Dakota. A little over 60 percent of the average annual net growth of sawtimber came from the ponderosa pine forest type on South Dakota BIA timberlands. The other major forest types contributing to average annual net growth of sawtimber on South Dakota BIA timberlands were elm-ash-cottonwood with 21 percent and oak-hickory with 16 percent.

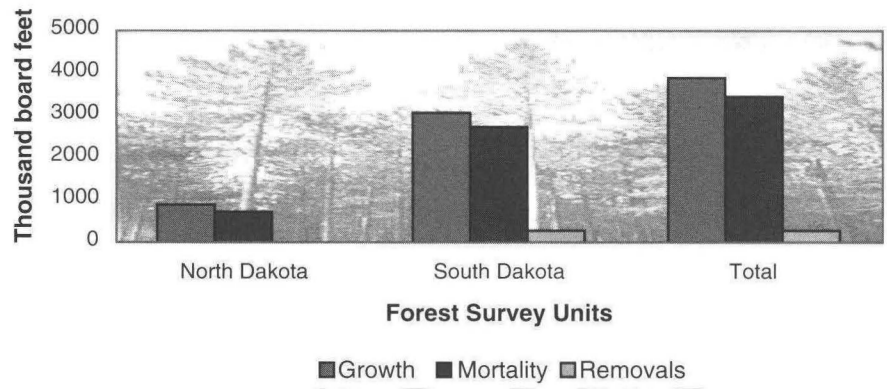


Figure 16.—*Average annual net growth, mortality, and removals of sawtimber on timberland, North Dakota BIA, 1980-1993, and South Dakota BIA, 1980-1995.*

MORTALITY

Mortality in Growing Stock

Average annual mortality for growing stock on BIA timberlands in North and South Dakota was estimated at 1.2 million cubic feet between 1980 and 1995. Average annual mortality as a percentage of total volume was 2 percent of the total growing-stock volume on North Dakota BIA timberlands and 1 percent of the total growing-stock volume on South Dakota BIA timberlands. On North Dakota BIA timberlands, average annual mortality equaled 11 cubic feet per acre per year between 1980 and 1993. On South Dakota BIA timberlands, average annual mortality equaled 8 cubic feet per acre per year between 1980 and 1995. Quaking aspen made up 67 percent of the growing-stock average annual mortality on North Dakota BIA timberlands, followed by balsam poplar with 19 percent of the mortality and elm with 12 percent. On South Dakota BIA timberlands, cottonwood made up 40 percent of the growing-stock average annual mortality, followed by ponderosa pine with 27 percent of the mortality and elm with 13 percent.

Mortality in Sawtimber

Average annual sawtimber mortality was 721 thousand board feet on North Dakota BIA timberlands and 2.7 million board feet on South Dakota BIA timberlands. Aspen accounted for more than half (383 thousand board feet) of all sawtimber mortality on North Dakota BIA timberlands. Cottonwood accounted for 46 percent or 1.2 million board feet of all sawtimber mortality on South Dakota BIA timberlands.

REMOVALS

Average annual growing-stock removals for North and South Dakota BIA timberlands between 1980 and 1995 was 54 and 89 thousand cubic feet, respectively. This averages out to be 0.3 percent of the growing-stock volume for North Dakota BIA and 0.1 percent of the growing-stock volume for South Dakota BIA timberlands. Quaking aspen accounted for 69 percent of growing-stock removals on North Dakota BIA timberlands, and green ash and elm accounted for 75 percent of growing-stock removals on South Dakota BIA timberlands.

In 1994, the aspen-birch forest type accounted for 58 percent of North Dakota BIA timberland area and all of the average annual growing-stock removals. The elm-ash-cottonwood forest type, which accounted for 12 percent of South Dakota BIA timberland area, had the highest amount of average annual growing-stock removals with 74 percent of the total.

APPENDIX

RELIABILITY OF THE SURVEY

Forest Inventory and Analysis information is based on a sampling procedure designed to provide reliable statistics at the State level. Consequently, the reported figures are estimates only. A measure of reliability of these figures is given by sampling errors (table A). These sampling errors mean that the chances are two out of three that if a 100-percent inventory had been made, using the same methods, the results would have been within the limits indicated.

For example, the estimated growing-stock volume in BIA timberlands was 83.7 million cubic feet, with a sampling error of ± 8.5 percent (± 7.1 million cubic feet). The growing-stock volume from a 100-percent inventory would be expected to fall between 90.8 million cubic feet and 76.6 million cubic feet (83.7 ± 7.1), there being a one in three chance that this is not the case.

Table A.—*Sampling errors for the 1994 and 1996 inventories of North and South Dakota's BIA timberlands*

Item	BIA totals	Sampling error
Growing stock	*Million cubic feet*	*Percent*
Volume (1994/1996)	83.7	8.5
Average annual growth (1980-1993/1980-1995)	1.7	15.0
Average annual removals (1980-1993/1980-1995)	0.1	67.8
Sawtimber	*Million board feet*	
Volume (1994/1996)	264.6	11.9
Average annual growth (1980-1993/1980-1995)	3.9	21.9
Average annual removals (1980-1994/1980-1996)	0.3	69.0
	Thousand acres	
Timberland area (1994)	131.3	6.4

As survey data are broken down into sections smaller than BIA totals, the sampling error increases. For example, the sampling error for volume for a species group is higher than that for total volume on BIA timberland. To estimate sampling error for data smaller than BIA totals, use the following formula:

$$E = \frac{(SE)\sqrt{(\text{BIA total volume or area})}}{\sqrt{(\text{Volume or area smaller than BIA total})}}$$

Where :

E = Sampling error in percent.

SE = BIA total error for volume or area.

For example, to compute the error on the growing-stock volume in the bur oak species group for North Dakota BIA timberlands, proceed as follows:

1) Total bur oak GS Volume (North Dakota BIA) = 3,792 thousand cubic feet.
2) Total BIA GS Volume = 83,705 thousand cubic feet.
3) The BIA total error for GS Volume = 8.5 percent.
4) Using the above formula:

$$E = \frac{0.085\sqrt{83{,}705}}{\sqrt{3{,}792}}$$

E = 39.9 percent sampling error for the bur oak species group in North Dakota BIA timberland. Sampling errors for area, volume, growth, and removals, for both growing stock and sawtimber, by BIA sampling units are shown in table 17.

COMPARING THE 1994 NORTH DAKOTA AND 1996 SOUTH DAKOTA INVENTORIES WITH THE 1980 INVENTORIES IN THESE TWO STATES

All volumes and biomass estimates presented in this report are based on methods presented in Hahn and Hansen (1984). A different volume estimation procedure developed for Minnesota's prairie region was used to compute the volumes published in the 1980 inventory reports. The newer methods were used to recompute the 1980 inventories where comparisons are presented in this report. Although the adjustment will differ by species, the recomputed 1980 growing-stock and sawtimber volumes will generally be greater than those shown in the 1980 report.

Past surveys used only growing-stock trees to determine stand-size class. Current survey procedures require that stand-size class be determined on the basis of all live trees. Therefore, direct comparisons of current inventory data to old inventory data by stand-size class may be misleading.

SURVEY PROCEDURES

The inventory of BIA lands in North and South Dakota was part of the statewide inventories of the two States, which sampled all forest lands across both States, without regard to ownership. The North Dakota inventory covered all lands in the State and the South Dakota inventory covered all lands in the State outside the Black Hills National Forest. The Black Hills National Forest was inventoried at a different time. The BIA provided additional funding to the Forest Service to measure more plots within all reservations in these two States. The inventory was designed to provide statewide information, but the intensified sampling

allows a breakdown of this information for BIA lands. A summary of the procedures used in these two statewide inventories is presented here with references to the intensification on BIA lands. This summary consists of three parts:

1) A description of the statistical design used in the inventory, which deals with the methods used for stratification, aerial photo, and ground plot selection and estimation.

2) A description of the ground plot measurements which focuses on the plot design and changes in the design between the 1980 and the 1994-1996 inventories.

3) A description of the methods used to compute items presented in this report (area, number of trees, volume, growth, mortality, removals, and biomass) from field plot measurements.

STATISTICAL DESIGN

The basic design for this inventory consists of two independent samples that were combined to provide an overall estimate of the forest resources of the Dakotas. The first sample is based on the remeasurement of the 1980 NCFIA inventory, and the second sample is based on the Natural Resource Conservation Service's Natural Resources Inventory (NRCS-NRI). These samples produced two independent estimates of the total forest resource in the two States and were combined, using statistically appropriate methods, to provide the best overall estimates possible.

SAMPLE BASED ON THE REMEASUREMENT OF THE 1980 NCFIA INVENTORY

The first sample was based on the remeasurement of aerial photo and ground plots taken during the 1980 NCFIA inventories of North and South Dakota. These inventories used double (two phase) sampling for stratification as presented in various texts on sampling such as Cochran (1977) and Loetsch and Haller (1964). Aerial photo plots were observed in the first phase and ground measurement or field plots were measured in the second phase.

1980 NCFIA INVENTORY AERIAL PHOTO PLOTS (PHASE 1)

The first phase of the 1980 inventory was a systematic sample of aerial photo plots distributed over the entire State. Sampling was completed using a grid at the intensity of 121 photo plots per township (6 miles by 6 miles). This provided a phase 1 sampling rate of one photo plot per 190.4 acres. Each photo sample plot was classified as forest, nonforest, questionable (samples where the photo interpreter was unable to make a definite call between forest and nonforest), or unproductive. The distribution of photo plots by aerial photo classification in the 1980 NCFIA forest inventory is shown in table B.

1980 NCFIA INVENTORY GROUND PLOTS (PHASE 2)

A systematic sample of the aerial photo plots was selected as ground plots in phase 2 of the 1980 inventory. Within the two States, a total of 24,446 ground plots were selected from the 478,210 photo plots. These ground plot locations were carefully examined stereoscopically, pin pricked on the aerial photo, and assigned a ground plot identification number. Ground plots that definitely were not forest land were given a nonforest ground land-use classification (more detailed than the photo classification done on all photo plots) by the photo interpreter and not sent to the field for measurement. These plots are referred to as office ground plots. Ground plot locations that could possibly be forest land (those classified as forest, questionable, or unproductive) were

Table B.—*Number of aerial photo plots in the 1980 inventory of North and South Dakota*

	North Dakota statewide inventory	South Dakota inventory outside BHNF	Both States, BIA lands only
Forest	2,848	4,222	992
Questionable	247	530	109
Unproductive	401	59	65
Nonforest	223,397	246,506	65,965
Total	226,893	251,317	67,131

Table C.—*Number of ground plots in the 1980 inventory of North and South Dakota*

	North Dakota statewide inventory	South Dakota inventory outside BHNF	Both States, BIA lands only
Forest	219	429	91
Questionable	19	75	13
Unproductive	31	8	5
Nonforest	17,183	6,085	3,266
Total	17,452	6,597	3,375

sent to the field for ground classification. The ground plot sampling intensity varied by inventory unit and was as low as one ground plot per 2,541 acres in North Dakota and as high as one ground plot per 6,892 in eastern South Dakota. The distribution of ground plots by aerial photo classification in the 1980 NCFIA inventory is shown in table C.

Estimates of the forest resources presented in 1980 inventory reports are based on double sampling for stratification based on these four strata.

REMEASUREMENT OF THE 1980 NCFIA INVENTORY

The aerial photo classification completed in the 1980 inventory was used for stratification in the first sample of the 1994-1996 North and South Dakota forest resources inventory. These 478,210 photo plots were used as the phase 1 sample to estimate the area in each of the four strata. The second phase used plots that were visited by field crews to sample and observe ground conditions (land use, volume, growth, mortality, removals, etc.) within the four strata.

The 1980 ground plots measured in the field form the second phase of this sample. In the forest, questionable, and unproductive strata, remeasurement observations of every systematic ground plot location established during the 1980 inventory were used to estimate average ground conditions within each strata in 1994. In the nonforest stratum, a cluster sampling scheme (using townships as clusters) was used to make repeated ground observations of the photo plots established in the 1980 inventory.

This sampling scheme was selected to improve our ability to estimate the area of forest, with particular emphasis on estimating the actual area of land change to and from forest. Because

all stratification was based on the same photo classification used in the previous inventory, estimates of change in forest area cannot be biased by differences in the quality of the aerial photography, the equipment and techniques used, and the individual photo interpreters and their skills. This design maintained the same level of intensity as the previous inventory in the strata where most of the forest land was found in the 1980 inventory (the forest and questionable strata) and in those strata from which most of the additional forest land was anticipated to come (the unproductive stratum). The photo plots that were classified as nonforest in the 1980 inventory were, by far, the largest portion of the 1980 photo sample. In addition, on a plot by plot basis, this stratum was anticipated to have a low probability of currently being forest. Cluster sampling provided an efficient sample of this large area with a low probability of change, by examining a large number of locations at two points in time.

Where double sampling was used in the forest, questionable, and unproductive classifications, the ground plot sampling intensity was one plot per 2,876 acres in North Dakota and one plot per 1,774 acres in South Dakota. In the nonforest stratum where cluster sampling was used, 155 townships from the total of 3,902 townships in the region were sampled. The ground plot intensity in this region for the nonforest without tree stratum was 9,427 acres per plot. On BIA lands, additional new plots were established at existing aerial photo plots to approximately double the ground plot intensity.

Every ground plot in the 1994 inventory was classified for disturbance and other changes that may have taken place between 1980 and 1994. Disturbed plots are those plots that showed evidence of harvesting, insect or disease damage, land-use change, or other significant changes since the last inventory. A subset of the undisturbed forest ground plots was not remeasured. Instead, these plots were updated using the Stand and Tree Evaluation Modeling System (STEMS) (Belcher *et al.* 1982). The undisturbed forest plots that were remeasured were used to adjust the STEMS model for discrepancies between updated and actual remeasurements using methods presented in Hansen (1990) that have been used in the previous NCFIA inventories in Michigan, Minnesota, Iowa, Missouri, and Wisconsin. The undisturbed forest plots that were not remeasured are referred to as pseudo-remeasurement plots because they contain all the data normally collected on a remeasure-ment plot (new plot and tree level data) but without the expense of a field visit. This methodology has been very efficient in other States inventoried by NCFIA. Because these undisturbed forest plots were not remeasured, other resources were available to establish additional ground plots for the second inventory based on the NRCS-NRI.

SAMPLE BASED ON THE NRCS-NRI

Just before this inventory, the Natural Resources Conservation Service (NRCS) conducted its National Resources Inventory (NRI) in the Plains States (U.S. Department of Agriculture, Soil Conservation Service 1991) using a two-stage sampling design. This sample design consisted of 160-acre and 640-acre primary sampling units (PSU) with three 2-acre secondary sampling units (SSU) located within the PSUs. The NRCS-NRI inventory sampled all lands except those owned by the Federal government. Estimates of the 1994 forest resources on Federal lands (primarily Forest Service, Corps of Engineers, and Bureau of Indian Affairs lands) come entirely from the NCFIA inventory described in the previous section. The data collected in the NRI formed the basis for stratification of the second independent inventory.

This second portion of the overall inventory of the North and South Dakota forest resources used the NRCS-NRI area estimates and point data as its basis for stratification and ground plot location in a double sampling scheme similar to the first portion of the inventory (the NCFIA remeasurement of the 1980 field ground plots). The number of 2-acre SSU plots sampled by NRCS-NRI are shown in table D.

Table D.—*Number of NRI-SSU plots available for remeasurement in the inventory of North and South Dakota*

	North Dakota state-wide inventory	South Dakota inventory outside BHNF	Both States, BIA lands only
Forest (20 percent tree cover or greater)	2,721	841	584
Nonforest (less than 20 percent tree cover)	234,858	192,495	70,030
Total	237,579	193,336	70,614

NCFIA photo classified and installed standard NCFIA field ground plots on a subset of the NRI-SSU plot locations. The selection criteria used resulted in a random sample of 5 percent of all PSUs and established plots at all three SSU points within this 5-percent sample. In addition, any SSU having 20 percent or greater tree cover was also included in the NCFIA sample. This subsampling of the NRI (5 percent of the less than 20 percent tree cover and 100 percent of the 20 percent or more tree cover) formed the basis of the estimation of means within strata. The average sampling intensity was approximately one ground plot per 6,000 acres in the forest stratum and one ground plot per 60,000 acres in the nonforest stratum.

COMBINED ESTIMATE BASED ON THE TWO INDEPENDENT INVENTORIES

These two inventories produced two independent estimates of the forest resources. Final estimates presented in this report are based on weighted averages from these two independent estimates. Weighting was proportional to the number of ground plots on forest land for the estimates of most items including area, number of trees, volume, growth, mortality, and biomass. Weighting based on the number of remeasurement plots on forest land was used for estimates of items that can only be obtained from remeasurement plots, including removals and area change over time.

FIELD MEASUREMENTS: 1980 INVENTORY PLOT DESIGN

On plots classified as timberland, wooded pasture, or windbreak (at least 120 feet wide), a ground plot was established or remeasured, or the growth and mortality of its trees were predicted using the STEMS models. Old plots selected for remeasurement that could not be relocated were replaced with new plots at the approximate locations of the old plots. Each ground plot consisted of a cluster of 10 subplots collectively covering approximately 1 acre. Trees 5.0 inches or greater in d.b.h. were sampled using 37.5 basal area factor (BAF) variable-radius plots, and trees less than 5.0 inches d.b.h. were sampled on 6.8-foot radius (1/300th acre) microplots established at the centers of subplots 1, 2, and 3. Under the estimation procedures used for this inventory, an entire plot was represented by a single condition class where condition was determined by forest type, stand-size class, land use, stand origin, and density. Thus, the arrangement of the 10 subplots within the plot was adjusted if any subplots were located in condition classes different from that of subplot 1. In particular, if a subplot was located outside the condition class for the plot, it was re-established or rotated into the condition class used for the entire plot. For example, if

subplots 1 through 9 were located in forest land and subplot 10 was located in a pasture, then subplot 10 was rotated back into the forest land condition class.

FIELD MEASUREMENTS: 1994-1996 INVENTORY PLOT DESIGN

Field ground plots were established or remeasured, or the growth and mortality of their trees were predicted using the STEMS models for all forest lands (including reserved forest land, unproductive forest land, and timberland), wooded pasture, or windbreaks (at least 120 feet wide). Establishing ground plots on all forest lands represented a major change between the 1980 and the 1994-1996 inventories.

The new overall plot layout consisted of 10 subplots arranged in a cluster with 70 feet between subplots. The basic locations of plots and subplots were the same as in the 1980 plot layout. All trees less than 5 inches in d.b.h. were measured on 6.8-foot radius (1/300th acre) microplots established at the centers of all 10 subplots. (In 1980, these microplots were measured only on subplots 1, 2, and 3). This radius was the maximum distance at which a 5.0-inch-d.b.h. tree would be selected using a basal area factor (BAF) of 37.5. Trees with diameters between 5.0 and 17.0 inches were selected for measurement at each of the 10 subplots with a BAF of 37.5. All trees greater than 17.0 inches d.b.h. located within a 24-foot radius macroplot centered at each of the 10 subplots were selected for measurement.

In the new plot design, subplots of the same plot were not rotated, even if they were located in multiple condition classes or straddled condition classes. As in 1980, factors determining condition class were forest type, stand-size class, land use, stand origin, and density. Plots with multiple condition classes were mapped in the field to record how the boundaries between classes split the plot. This procedure identified the area of the plot located in each class and assigned each tree to a specific class. When multiple condition classes occurred on a plot, all information normally collected for the plot as a whole, such as forest type, site index, stand age, and stand-size class, was collected for each condition class.

On remeasured plots, the rotated subplots and all trees measured from the 1980 plot design were also remeasured to obtain change data such as growth and mortality. On new plots, subplots were not rotated.

NEW INVENTORY PLOTS

New ground plots were selected from the plots identified in NCFIA's evaluation of the NRCS-NRI inventory. These new ground plots were established, and measures of current classification such as land use, forest type, and ownership, as well as size and condition of all trees on the plot, were recorded. These locations were monumented for future remeasurement.

OLD INVENTORY PLOTS

Old inventory plots are those plots established, monumented, and measured as part of the 1980 field inventory. The Inventory procedures used for these old plots were different from those used for new plots. Old plots were classified as "disturbed" on the basis of aerial photo analyses if either:1) a reduction in vegetation on the plot occurred between inventories that resulted in a detectable change in the structure or function of the plant community; or 2) conditions on the plot were such that the STEMS models were unable to accurately predict growth or mortality. Plots not predicted to be disturbed were classified as "undisturbed." All disturbed plots and a one-third sample of the undisturbed plots were field remeasured to obtain estimates of current conditions and changes since the last inventory. All remaining live trees measured on these plots in 1980 were remeasured, and all new trees were identified and measured.

Of the timberland plots measured in 1980, many were not remeasured for the 1996 inventory. On BIA lands, a total of 6 timberland plots were classified "undisturbed" and not remeasured (table E). Growth and mortality for these plots were predicted using the STEMS models as a means of obtaining growth and current volume. A comparison of the predicted growth and mortality for these undisturbed plots and observations of growth and mortality for the one-third sample of remeasured undisturbed plots was used to adjust the model predictions to accommodate local conditions. The adjustment procedure is a modified version of the method described by Smith (1983).

The undisturbed timberland plots whose growth and mortality were predicted were treated in the estimation process as measured ground plots, even though they were not visited by field crews. The plot records for these plots were sent to the field for verification of current ownership information. All old plots classified as disturbed were selected for remeasurement to assess and verify changes since the last inventory. Table E summarizes the distribution of all ground plots by type and plot.

Table E.—*Distribution of ground plots by ground land-use class and type of plot, 1994-1996 inventory of the North Dakota and South Dakota forest resources*

	Sample base [1]			
	1980 NCFIA Remeasurement		NRCS-NRI	
	Remeasured	Updated	New	Total plots
North Dakota statewide inventory				
Timberland	125	48	85	258
Other forest land	44	0	12	56
Nonforest with trees	333	13	80	426
Nonforest without trees	8,994	10	734	9,738
Water	121	0	10	131
Total	9,617	71	921	10,609
South Dakota inventory outside the Black Hills National Forest				
Timberland	322	10	76	408
Other forest land	33	0	6	39
Nonforest with trees	437	1	94	632
Nonforest without trees	5,995	0	739	6,734
Water	101	0	4	105
Total	6,888	11	919	7,918
Both States, BIA lands only				
Timberland	63	6	62	131
Other forest land	11	0	6	17
Nonforest with trees	109	0	66	175
Nonforest without trees	2,117	0	560	2,677
Water	31	0	5	36
Total	2,331	6	699	3,036

[1] *Plots that straddle more than one land use are included in this table in the land-use class that occurs first on this list. For example, a plot that straddled other forest land and water would be includd in this table as other forest land.*

COMPUTATION OF ESTIMATES

Area

All area estimates were made using two-phase estimation methods. In this type of estimation, a preliminary estimate of area by land use is obtained from stratification (Phase 1) and corrected by plot measurements (Phase 2). A complete description of these methods is presented by Loetsch and Haller (1964).

Volume

Estimates of volume per acre were made from the measurements and predictions for trees on each of the 10 subplots per plot. For each condition class on a plot, the volume per acre estimate was multiplied by the area estimate represented by the condition, and these products were summed over all plots to obtain estimates of total volume for the condition class. Net cubic and board foot volumes are based on tree measurements (d.b.h., tree class, and site index) and volume equations presented by Hahn and Hansen (1984).

Growth and Mortality

On remeasured plots, estimates of growth and mortality per acre were derived from remeasurements and observations of trees that died between inventories. These estimates were based on the remeasurement of the 1980 inventory plots using the 1980 plot design. Growth, reported as average annual net growth between the 1980 and 1994 inventories, was computed from data for both plots that had been remeasured and plots whose growth and mortality had been predicted using methods presented by Van Deusen *et al.* (1986). Average annual mortality was also calculated for the remeasurement period.

On new plots, estimates of growth and mortality were obtained by using the STEMS models to predict growth and mortality for 1 year. Current diameter and living tree estimates for old undisturbed plots were predicted using growth and mortality predictions and were derived in the same manner as for remeasured plots. To accommodate local conditions, predictions of growth and mortality from the STEMS models were adjusted using data from the undisturbed remeasured plots. As with volume, total growth and mortality estimates were obtained by multiplying the plot-level per acre estimates by area expansion factors and then summing over plots. Current annual net growth for 1994 was computed using adjusted, 1-year STEMS predictions of growth for all inventory plots.

Average Annual Removals

Average annual growing-stock and sawtimber removals (1980-1993) were estimated only from the remeasured plots. These estimates were based on the remeasurement of the 1980 inventory plots using the 1980 plot design. Measurements for new plots and predictions from the STEMS models were not used to estimate removals. These estimates were obtained from trees measured in the last inventory and either cut or otherwise removed from the timberland base. Because remeasurement plots constitute about one-half the total ground plots, and not all remeasured plots had cutting, average annual removals estimates have greater sampling errors than volume and growth estimates.

TREE AND LOG GRADES

The Forest Service reports all board foot volume in International 1/4-inch rule. In the Dakotas, the Scribner log rule is commonly used. Scribner log rule conversion factors were derived from full tree measurements and an equation developed by Wiant and Castenaeda (1977). The factors (multipliers) used to convert board foot International volumes to the Scribner rule are shown in the following tabulation:

D.b.h. (inches)	Scribner rule conversion factor	
	Softwoods	Hardwoods
9.0-10.9	0.7830	—
11.0-12.9	0.8287	0.8317
13.0-14.9	0.8577	0.8611
15.0-16.9	0.8784	0.8827
17.0-18.9	0.8945	0.8999
19.0-20.9	0.9079	0.9132
21.0-22.9	0.9168	0.9239
23.0-24.9	0.9240	0.9325
25.0-26.9	0.9299	0.9396
27.0-28.9	0.9321	0.9454
29.0+	0.9357	0.9544

Log grades and tree grades were based on the classification of external characteristics as indicators of quality. Log grades or tree grades were taken on approximately one-third of the sample plots. All sawtimber softwood sample trees were graded for quality and assigned a butt log grade. All sawtimber hardwood sample trees were graded for quality and assigned a tree grade. The volume yield by log grade or tree grade for this sample was used to distribute the volume of the ungraded sample trees by species group.

Hardwood sawtimber trees were graded according to "Hardwood tree grades for factory lumber" (Hanks 1976). The best 12-foot section of the lowest 16-foot hardwood log was used for grading. Hardwood sawtimber trees that did not meet minimum tree grade specifications for grades 1 through 3 were assigned grade 4 according to Forest Service standard specifications for hardwood construction logs described in "A guide to hardwood log grading" (Rast *et al.* 1973).

Ponderosa pine and other softwood sawtimber trees were graded according to USDA Forest Service specifications. For all softwoods, the first merchantable 16-foot log or shorter lengths down to 12 feet were used for grading.

Hardwood Tree Grade for Factory Lumber [a]

Grade factor	Tree grade 1	Tree grade 2	Tree grade 3
Length of grading zone (feet)	Butt 16	Butt 16	Butt 16
Length of grading section [b] (feet)	Best 12	Best 12	Best 12
D.b.h., minimum (inches)	16 [c]	13	11
D.i.b., minimum at top of grading section (inches)	13 [c] 16 20	11 [d] 12	8
Clear cuttings (on the 3 best faces) [e]			
Length, minimum (feet)	7 5 3	3 3	2
Number on face (maximum)	2	2 3	Unlimited
Yield in face length (minimum)	5/6	4/6	3/6
Cull deduction (including crook and sweep, but excluding shake) maximum within grading section (percent)	9	[f]	50

[a] *Hanks (1976)*

[b] *Whenever a 14- or 16-foot section of the butt 16-foot log is better than the best 12-foot section, the grade of the longer section will become the grade of the tree. This longer section, when used, is the basis for determining the grading factors such as diameter and cull deduction.*

[c] *In basswood and ash, d.i.b. at top of grading section must be 12 inches and d.b.h. must be 15 inches.*

[d] *Grade 2 trees can be 10 inches d.i.b. at top of grading section if they otherwise meet surface requirements for small grade 1's.*

[e] *A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.*

[f] *Fifteen percent crook and sweep or 40 percent total cull deduction are permitted in grade 2 trees, if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree's grade to 3 unless the cull deduction for rot is greater than 40 percent.*

Forest Service Standard Specifications for Hardwood Construction Logs (tie and timber logs) [a, b]

Position in tree	Butts and uppers
Minimum diameter, small end	8 inches
Minimum length without trim	8 feet
Clear cuttings	No requirements
Sweep allowance	One-fourth of the diameter at the small end for each 8 feet of length.
Sound surface defects:	
Single knots	Any number, if no one knot has an average diameter above the callus in excess of one-third of the log diameter at point of occurrence.
Whorled knots	Any number, if the sum of knot diameters above the callus does not exceed one-third of the log diameter at point of occurrence.
Holes	Any number, provided none has a diameter over one-third of the log diameter at point of occurrence and none extends more than 3 inches into included timber [c].
Unsound surface defects:	Same requirements as for sound defects if they extend into included timber. No limit if they do not.

[a] *Rast et al. (1973).*

[b] *These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only nonfactory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, it may be necessary to subdivide the class into grades.*

[c] *Included timber is always square, and dimension is judged from small end.*

Log Grades for Ponderosa Pine and Other Softwoods

Grade 1

1. Trees must be 16 inches in diameter or larger, grading section 12 feet in length or longer, and with deduction for defect not over 30 percent of gross scale.
2. Trees must be at least 75 percent clear on each of three faces.
3. All knots outside clear cutting must be sound and not more than 2-1/2 inches in size.

Grade 2

1. Trees must be 12 inches in diameter or larger, grading section 12 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross scale deducted for defect.
2. Trees must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade 3

1. Trees must be 6 inches in diameter or larger, grading section 12 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.

Note: Diameters are diameter inside bark (d.i.b.) at small end of grading section. Percent clear refers to percent clear in one continuous section.

METRIC EQUIVALENTS

1 acre = 4,046.86 square meters or 0.405 hectare.
1,000 acres = 405 hectares.
1 cubic foot = 0.0283 cubic meter.
1 foot = 30.48 centimeters or 0.3048 meter.
1 inch = 25.4 millimeters, 2.54 centimeters, or 0.0254 meter.
1 pound = 0.454 kilograms.
1 ton = 0.907 metric tons.

TREE SPECIES GROUPS IN NORTH AND SOUTH DAKOTA (LITTLE 1981)

Hardwoods

Silver maple [2] ..... *Acer saccharinum*
Paper birch [2] ..... *Betula papyrifera*
River birch [2] ..... *B. nigra*
Hackberry [2] ..... *Celtis occidentalis*
Ashes
  Black ash [2] ..... *Fraxinus nigra*
  Green ash [1] ..... *F. pennsylvanica*
Cottonwoods [2]
  Eastern cottonwood ..... *Populus deltoides*
  Plains cottonwood ..... *P. sargentii*
Balsam poplar [2] ..... *P. balsamifera*
Quaking aspen [2] ..... *P. tremuloides*
Black cherry [2] ..... *Prunus serotina*
Select white oaks [1]
  Bur oak ..... *Quercus macrocarpa*
Black willow [2] ..... *Salix nigra*
American basswood [2] ..... *Tilia americana*
Elms
  American elm [2] ..... *Ulmus americana*
  Siberian elm [2] ..... *U. pumila*
  Slippery elm [2] ..... *U. rubra*
Other hardwoods
  Boxelder [2] ..... *Acer negundo*
  White poplar [2] ..... *Populus alba*

Softwoods [2]

Rocky Mountain juniper ..... *Juniperus scopulorum*
Eastern redcedar ..... *J. virginiana*
Ponderosa pine ..... *Pinus ponderosa*
White spruce ..... *Picea glauca*
Other softwoods
  Blue spruce ..... *P. pungens*

Noncommercial species

Eastern hophornbeam ..... *Ostrya virginiana*
Hawthorn ..... *Crataegus* spp.
Wild plum ..... *Prunus* spp.
Chokecherry ..... *P. virginiana*
Pin cherry ..... *P. pensylvanica*
Canada plum ..... *P. nigra*
Diamond willow ..... *Salix bebbiana*
White willow ..... *S. alba*
Peachleaf willow ..... *S. amygdaloides*

[1] *This species or species group is considered a hard hardwood, with an average specific gravity greater than or equal to 0.50.*

[2] *This species or species group is considered a softwood or a soft hardwood, with an average specific gravity of less than 0.50.*

Note: Many additional tree species have been planted around homesteads and farm headquarters in rural North and South Dakota, in urban settings, and in tree plantings. However, only those species encountered during the third inventory of the forest resources of North and South Dakota are listed here. For a complete list of all of the tree species, please contact the North or South Dakota Forest Service or your local Extension Service office.

DEFINITION OF TERMS

Average annual mortality of growing stock

The average cubic foot volume of sound wood in growing-stock trees that died in one year. Average annual mortality is the average for the years between inventories (1980 through 1993 in this report).

Average annual mortality of sawtimber

The average board foot volume of sound wood in sawtimber trees that died in one year. Average annual mortality is the average for the years between inventories (1980 through 1993 in this report).

Average annual removals from growing stock

The average net growing-stock volume in growing-stock trees removed annually for roundwood forest products, in addition to the volume of logging residues and the volume of other removals. Average annual removals of growing stock is the average for the years between inventories (1980 through 1993 in this report) and is based on information obtained from remeasurement plots (see Survey Procedures in the appendix).

Average annual removals from sawtimber

The average net board foot sawtimber volume of live sawtimber trees removed annually for roundwood forest products, in addition to the volume of logging residues, and the volume of other removals. Average annual removals of sawtimber is the average for the years between inventories (1980 through 1993 in this report) and is based on information obtained from remeasurement plots (see Survey Procedures in the appendix).

Average annual net growth of growing stock

The annual change in cubic foot volume of sound wood in live sawtimber and poletimber trees, and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes. Average net annual growing stock is the average for the years between inventories (1980 through 1993 in this report).

Average annual net growth of sawtimber

The annual change in the board foot volume of live sawtimber trees, and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes. Average net annual growth of sawtimber is the average for the years between inventories (1980 through 1993 in this report).

Basal area

Tree area in square feet of the cross section at breast height (4.5 ft) of a single tree. When the basal areas of all trees in a stand are summed, the result is usually expressed as square feet of basal area per acre.

Biomass

The aboveground volume of all live trees (including bark but excluding foliage) reported in green tons (i.e., green weight). Biomass has four components:

Bole.—Biomass of a tree from 1 foot above the ground to a 4-inch top outside bark.

Tops and limbs.—Total biomass of a tree from a 1-foot stump minus the bole.

1- to 5-inch trees.—Total aboveground biomass of a tree from 1 to 5 inches in diameter at breast height.

Stump.—Biomass of a tree 5 inches d.b.h. and larger from the ground to a height of 1 foot.

Bolts

Roundwood logs of less than 8 feet in length that are converted into shingles, cooperage stock, dimension stock, blocks, blanks, excelsior, etc. No minimum diameter limits. Does not include logs used for the manufacture of pulp or veneer.

Commercial species

Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality.)

Cord

One standard cord is 128 cubic feet of stacked wood, including bark and air space. Cubic feet can be converted to solid wood standard cords by dividing by 79.

Corporate

Lands owned by a private corporation not in the business of operating primary wood-using plants.

County and municipal land

Land owned by counties and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Cropland

Land under cultivation within the last 24 months, including cropland harvested, crop failures, cultivated summer fallow, idle cropland used only for pasture, orchards, active Christmas tree plantations indicated by annual shearing, nurseries, and land in soil improvement crops, but excluding land cultivated in developing improved pasture.

Cull

Portions of a tree that are unusable for industrial wood products because of rot, missing or dead material, form, or other defect.

Current annual net growth of growing stock

The annual change in volume of sound wood in live sawtimber and poletimber trees, and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes, reported for a single year (1993 in this report). Current growth is based on an estimate of the current annual increment of each growing-stock tree in the inventory.

Current annual net growth of sawtimber

The annual change in the volume of live sawtimber trees, and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes, reported for a single year (1993 in this report). Current growth is based on an estimate of the current annual increment of each growing-stock tree in the inventory.

Current annual removals from growing stock

The current net growing-stock volume in growing-stock trees removed annually for roundwood forest products, in addition to the volume of logging residues, and the volume of other removals. Current annual removals of growing stock is reported for a single year (1993 in this report); it is based on a survey of primary wood processing mills to determine removals for products and on information from remeasurement plots (see Survey Procedures in the appendix) to determine removals due to land-use change.

Current annual removals from sawtimber

The current net board foot sawtimber volume of live sawtimber trees removed annually for roundwood forest products, in addition to the volume of logging residues, and the volume of other removals. Current annual removals of sawtimber is reported for a single year (1993 in this report); it is based on a survey of primary wood processing mills to determine removals for products and on information from remeasurement plots (see Survey Procedures in the appendix) to determine removals due to land-use change.

Diameter class

A classification of trees based on diameter outside bark, measured at breast height 4.5 feet above the ground. (Note: d.b.h. is the common abbreviation for diameter at breast height.) Two-inch diameter classes are commonly used in Forest Inventory and Analysis, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Diameter at breast height (d.b.h.)

The outside bark diameter at 4.5 feet (1.37 m) above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Forest industry land

Land owned by companies or individuals operating primary wood-using plants.

Forest land

Land at least 10 percent stocked (Note: historically, 16.7 percent was used based on full stocking equaling 167 percent. Consequentially, this equaled a standard of 10 percent based on the 100-percent scale that is now used) by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide. (See Tree, Land, Timberland, Reserved forest land, Other forest land, Stocking, and Water.)

Forest type

A classification of forest land based on the species forming a plurality of live tree stocking. The associated species for each forest type are based on net volume of growing stock and all live biomass by species group and forest type from the

1994-1996 inventory of North and South Dakota forests. Major forest types found are:

Ponderosa pine.—Forests in which ponderosa pine comprises a majority of the forest stocking.

Rocky Mountain juniper.—Forests in which Rocky Mountain juniper comprises a majority of forest stocking. A common associate of the Rocky Mountain juniper forest type is green ash.

Bur oak.—Forests in which bur oak comprises a majority of forest stocking. Species commonly associated with the bur oak forest type in North and South Dakota include basswood and green ash.

Cottonwood.—Forests in which cottonwood comprises a majority of the forest stocking. A common associate of the cottonwood forest type in North and South Dakota is green ash.

Elm-ash-cottonwood.—Lowland forests in which cottonwood, green ash, and elm comprise a plurality of the forest stocking. A common associate of the elm-ash-cottonwood forest type in North and South Dakota is bur oak.

Basswood.—Forests in which hardwoods comprise a plurality of the forest stocking. Species commonly associated with the basswood forest type in North and South Dakota include bur oak and green ash.

Aspen-birch.—Forests in which quaking aspen, paper birch, and river birch, singly or in combination, comprise a plurality of forest stocking. Species commonly associated with the aspen-birch forest type in North and South Dakota include balsam poplar, bur oak, and green ash.

Elm-ash.—Upland forests in which elm and green ash comprise a plurality of the forest stocking. Species commonly associated with the elm-ash forest type in North and South Dakota include cottonwood and bur oak.

Growing-stock tree

A live tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume

Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0-inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hard hardwoods

Hardwood species with an average specific gravity greater than 0.50 such as oaks, hard maple, hickories, and ash.

Hardwoods

Dicotyledonous trees, usually broad-leaved and deciduous. (See Soft hardwoods and Hard hardwoods.)

Improved pasture

Land currently improved for grazing by cultivating, seeding, irrigating, or clearing trees or brush and less than 10 percent stocked with trees.

Indian land

Land held in trust by the United States for tribes or individual Indians.

Industrial wood

All roundwood products except residential fuelwood.

Land

(a) Bureau of the Census.—Dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains, streams, sloughs, estuaries, and canals less than one-eighth of a statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

(b) Forest Inventory and Analysis.—The same as the Bureau of the Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is 1 acre.

Live trees

Growing-stock, rough, and rotten trees 1.0 inch d.b.h. and larger.

Log grade

A log classification based on external characteristics as indicators of quality or value. Log grade was assigned to a sample of softwood sawtimber trees throughout the States during the 1994 inventory. Also see Tree grade. (See appendix for specific grading factors used.)

Logging residue

The unused portions of the merchantable central stem of growing-stock trees cut or killed by logging.

Marsh

Nonforest land that characteristically supports low, generally herbaceous or shrubby vegetation, and that is intermittently covered with water.

Merchantable

Refers to a pulpwood or saw log section that meets pulpwood or saw log specifications, respectively.

Miscellaneous Federal land

Federal land other than national forest and land administered by the Bureau of Land Management, Corps of Engineers, or Bureau of Indian Affairs.

National forest land

Federal land that has been legally designated as national forest or purchase units, and other land administered by the USDA Forest Service. For example, the administrative unit in North Dakota is named "Dakota Prairie Grasslands," and the administrative unit in South Dakota is the Black Hills National Forest.

Net volume

Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Noncommercial species

Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land

Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, active Christmas tree plantations as indicated by annual shearing, orchards, nurseries, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land.) If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide and more than 1 acre in area to qualify as nonforest land.

Nonforest land without trees.—Nonforest land with no live trees present.

Nonforest land with trees.—Nonforest land with one or more trees per acre at least 5 inches d.b.h.

Nonstocked land

Timberland less than 10 percent stocked with all live trees.

Other forest land

Forest land not capable of producing 20 cubic feet per acre per year of industrial wood crops under natural conditions and not associated with urban or rural development. Many of these sites contain tree species that are not currently used for industrial wood production or trees of poor form, small size, or inferior quality that are unfit for most industrial products. Unproductivity may be the result of adverse site conditions such as sterile soil, dry climate, poor drainage, high elevation, and rockiness. This land is not withdrawn from timber use.

Other removals

Growing-stock trees removed but not used for products, or trees left standing but "removed" from the timberland classification by land-use change. Examples are removals from cultural operations such as timber stand improvement work and land clearing, and the standing volume on land classified originally as timberland but later designated as reserved from timber harvesting (such as a newly established State park).

Pasture

Land presently used for grazing or under cultivation to develop grazing.

Plant byproducts

Plant residues used for products such as mulch, pulp chips, and fuelwood.

Plantation

An artificially reforested area sufficiently productive to qualify as timberland. The planted species is not necessarily predominant. Christmas tree plantations, which are considered cropland, are not included.

Plant residues

Wood and bark materials generated at manufacturing plants during production of other products.

Poletimber stand

(See Stand-size class.)

Poletimber tree

A live tree of commercial species at least 5.0 inches d.b.h., but smaller than sawtimber size.

Potential productivity class

A classification of forest land in terms of inherent capacity to grow crops of industrial wood. The class identifies the potential growth in merchantable cubic feet/acre/year at culmination of mean annual increment of fully stocked natural stands.

Private individual land

Privately owned land not owned by forest industry. This class includes the formerly used Farmer and Miscellaneous private classes.

Reserved forest land

Forest land withdrawn from timber use through statute, administrative regulation, or designation. Note: historically, Christmas tree plantations were classified as reserved forest land. However, Christmas tree plantations are now classified as cropland.

Rotten tree

Live trees of commercial species that do not contain at least one 12-foot saw log or two saw logs 8 feet or longer, now or prospectively, and/or do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough tree

(a) Live trees of commercial species that do not contain at least one merchantable 12-foot saw log or two saw logs 8 feet or longer, now or prospectively, and/or do not meet regional specifications for freedom from defect primarily because of roughness or poor form, and

(b) all live trees of noncommercial species.

Roundwood products

Logs, bolts, or other round sections (including chips from roundwood) cut from trees for industrial or consumer uses. (Note: Includes saw logs, veneer logs, and bolts; cooperage logs and bolts; pulpwood; fuelwood; pilings; poles; posts; hewn ties; mine timbers; and various other round, split, or hewn products.)

Salvable dead tree

A standing or down dead tree considered merchantable by regional standards.

Sapling

A live tree 1.0 to 5.0 inches d.b.h.

Sapling-seedling stand

(See Stand-size class.)

Saw log

A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight and with a minimum diameter outside bark (d.o.b.) for softwoods of 7.0 inches (9.0 inches for hardwoods) or other combinations of size and defect specified by regional standards.

Saw log portion

That part of the bole of sawtimber trees between the stump and the saw log top.

Saw log top

The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber stand

(See Stand-size class.)

Sawtimber tree

A live tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume

Net volume of the saw log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified otherwise), from stump to a minimum 7.0 inches top d.o.b. for softwoods and a minimum 9.0 inches top d.o.b. for hardwoods.

Seedling

A live tree less than 1.0 inch d.b.h. that is expected to survive. Only softwood seedlings more than 6 inches tall and hardwood seedlings more than 1 foot tall are counted.

Short-log (rough tree)

A sawtimber-size tree of commercial species that contains at least one merchantable 8- to 11-foot saw log but not a 12-foot saw log.

Shrub

A woody, perennial plant differing from a perennial herb in its persistent and woody stem(s) and less definitely from a tree in its lower stature and/or the general absence of a well-defined main stem. For this report, shrubs were separated somewhat arbitrarily into tall and low shrubs as follows:

Tall shrubs.—Normally taller than 1.6 to 3.2 feet

Low shrubs.—Normally shorter than 1.6 to 3.2 feet. (Woody perennial vines, such as grape, were included with low shrubs.)

Shrub and tree seedling biomass

The total aboveground weight of trees less than 1.0 inch in diameter and all shrubs.

Site index

An expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at age 50.

Soft hardwoods

Hardwood species with an average specific gravity less than 0.50, such as cottonwood, red maple, basswood, and willow.

Softwoods

Coniferous trees, usually evergreen, having needles or scale-like leaves.

Stand

A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand-age class

A classification based on age of the main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Stand-size class

A classification of stocked (see Stocking) forest land based on the size class of live trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

Sawtimber stands.—Stands with half or more of live tree stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Poletimber stands.—Stands with half or more of live tree stocking in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

Sapling-seedling stands.—Stands with more than half of the live tree stocking in saplings and/or seedlings.

State land

Land owned by the State of North or South Dakota or leased to it for 50 years or more.

Stocking

The degree of occupancy of land by all live trees, measured by basal area and/or the number of trees in a stand by size or age and spacing, compared to the basal area and/or number of trees required to fully use the growth potential of the land; that is, the stocking standard. A stocking percent of 100 indicates full use of the site and is equivalent to 80 square feet of basal area per acre in trees 5.0 inches d.b.h. and larger. In a stand of trees less than 5 inches d.b.h., a stocking percent of 100 would indicate that the present number of trees is sufficient to produce 80 square feet of basal area per acre when the trees reach 5 inches d.b.h.

Stands are grouped into the following stocking classes:

Overstocked stands.—Stands in which stocking of live trees is 100 percent or more.

Fully stocked stands.—Stands in which stocking of live trees is from 60 to 100 percent.

Medium stocked stands.—Stands in which stocking of live trees is from 35 to 60 percent.

Poorly stocked stands.—Stands in which stocking of live trees is from 10 to 35 percent.

Nonstocked areas.—Timberland on which stocking of live trees is less than 10 percent.

Timber products output

All timber products cut from roundwood and byproducts of wood manufacturing plants. Roundwood products include logs, bolts, or other round sections cut from growing-stock trees, cull trees, salvable dead trees, trees on nonforest land, noncommercial species, sapling-size trees, and limbwood. Byproducts from primary manufacturing plants include slabs, edging, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and screenings of pulpmills that are used as pulpwood chips or other products.

Timberland

Forest land that is producing, or is capable of producing, more than 20 cubic feet per acre per year of industrial wood crops under natural conditions, that is not withdrawn from timber use, and that is not associated with urban or rural development. Currently inaccessible and inoperable areas are included. (Timberland was formerly called commercial forest land.)

Tree

A woody plant usually having one or more erect perennial stems, a stem diameter at breast height of at least 3 inches, a more or less definitely formed crown of foliage, and a height of at least 13 feet at maturity.

Tree biomass

The total aboveground weight (including the bark but excluding the foliage) of all trees from 1 to 5 inches in d.b.h., and the total aboveground weight (including the bark but excluding the foliage) from a 1-foot stump for trees more than 5 inches in diameter.

Tree grade

A classification of the lower 16 feet of the bole of standing trees based on external characteristics as indicators of the quality and quantity of lumber that could be produced from the tree. Tree grade was assigned to a sample of hardwood

sawtimber trees during the 1994 inventory. Also see Log grade. (See appendix for specific grading factors used.)

Tree size class

A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Upper stem portion

That part of the bole of sawtimber trees above the saw log top to a minimum top diameter of 4.0 inches d.o.b. or to the point where the central stem breaks into limbs.

Urban and other areas

Areas within the legal boundaries of cities and towns; suburban areas developed for residential, industrial, or recreational purposes; school yards; cemeteries; roads; railroads; airports; beaches; powerlines and other rights-of-way; or other nonforest land not included in any other specified land-use class.

Urban forest land

Land that would otherwise meet the criteria for timberland, but that is in an urban-suburban area surrounded by commercial, industrial, or residential development and not likely to be managed for the production of industrial wood products on a continuing basis. Wood removed would be for land clearing, fuelwood, or esthetic purposes. Such forest land may be associated with industrial, commercial, residential subdivision, industrial parks, golf course perimeters, airport buffer strips, and public urban parks that qualify as forest land.

Water

(a) Bureau of the Census.—Permanent inland water surfaces, such as lakes, reservoirs, and ponds at least 40 acres in area; and streams, sloughs, estuaries, and canals at least one-eighth of a statute mile wide.

(b) Noncensus.—Permanent inland water surfaces, such as lakes, reservoirs, and ponds from 1 to 39.9 acres in area; and streams, sloughs, estuaries, and canals from 120 feet to one-eighth of a statute mile wide.

Wooded pasture

Improved pasture with more than 10 percent stocking in live trees, but less than 25 percent stocking in growing-stock trees. Area is currently improved for grazing or there is other evidence of grazing.

Wooded strip

An acre or more of natural continuous forest land that would otherwise meet survey standards for timberland except that it is less than 120 feet wide.

LITERATURE CITED

Belcher, D.W.; Holdaway, M.R.; Brand, G.J. 1982. A description of STEMS the stand and tree evaluation and modeling system. Gen. Tech. Rep. NC-79. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 18 p.

Cochran, W.G. 1977. Sampling techniques. New York, NY: John Wiley & Sons, Inc. 413 p.

Hahn, J.T.; Hansen, M.H. 1984. Cubic and board foot volume models for the Central States. Northern Journal of Applied Forestry. 8(2): 47-57.

Hanks, L.F. 1976. Hardwood tree grades for factory lumber. Res. Paper NE-333. Broomall, PA: U.S. Department of Agriculture, Forest Service. Northeastern Forest Experiment Station. 81 p.

Hansen, M.H. 1990. A comprehensive sampling system for forest inventory based on an individual tree growth model. St. Paul, MN: University of Minnesota, College of Natural Resources. 256 p. Ph.D. dissertation.

Haugen, David E.; Piva, Ronald J.; Kingsley, Neal P.; Harsel, Robert A. 1999. North Dakota's forest resources, 1994. Res. Pap. NC-336. St. Paul, MN: U.S. Depatment of Agriculture, Forest Service, North Central Research Station. 101 p.

Little, E.L. 1981. Checklist of native and naturalized trees of the United States. Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture, Forest Service. 385 p.

Loetsch, F.; Haller, K.E. 1964. Forest inventory, volume 1, Statistics of forest inventory and information from aerial photographs. Vienna: BLV Verlagsgesellschaft Munch Basle. 436 p.

Rast, E.D.; Sonderman, D.L.; Gammon, G.L. 1973. A guide to hardwood log grading. Gen. Tech. Rep. NE-1. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 31 p.

Smith, W.B. 1983. Adjusting the STEMS regional growth models to improve local predictions. Res. Note NC-297. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 5 p.

U.S. Department of Agriculture, Soil Conservation Service. 1991. Instructions for collecting 1992 National Resources Inventory sample data. Washington, DC: U.S. Department of Agriculture, Soil Conservation Service. 69 p.

Van Deusen, P.C.; Dell, T.R.; Thomas, C.E. 1986. Volume growth estimation from permanent horizontal points. Forest Science. 32: 415-422.

Wiant, H.V., Jr.; Castenaeda, F. 1977. Mesavage and Girard's volume tables formulated. BLM4. Denver, CO: U.S. Department of the Interior, Bureau of Land Management, Denver Service Center: 1-4.

TABLE TITLES

Table 1.—*Area of land by major land-use class, North and South Dakota, BIA lands, 1994 and 1996*

Table 2.—*Area of timberland by forest type group/local type and stand-size class, North Dakota BIA, 1994*

Table 2a.—*Area of timberland by forest type group/local type and stand-size class, South Dakota BIA, 1996*

Table 3.—*Area of timberland by Forest Survey Unit and potential productivity class, North and South Dakota BIA, 1994 and 1996*

Table 4.—*Area of timberland by stocking class of growing-stock trees, North and South Dakota BIA, 1994 and 1996*

Table 5.—*Number of all live trees on timberland by species group and diameter class, North Dakota BIA, 1994*

Table 5a.—*Number of all live trees on timberland by species group and diameter class, South Dakota BIA, 1996*

Table 6.—*Net volume of growing stock on timberland by species group and diameter class, North Dakota BIA, 1994*

Table 6a.—*Net volume of growing stock on timberland by species group and diameter class, South Dakota BIA, 1996*

Table 7.—*Net volume of growing stock and sawtimber on timberland by major species group, North and South Dakota BIA, 1994 and 1996*

Table 8.—*Net volume of growing stock on timberland by species group and local forest type, North Dakota BIA, 1994*

Table 8a.—*Net volume of growing stock on timberland by species group and local forest type, South Dakota BIA, 1996*

Table 9.—*Net volume of sawtimber on timberland by species group and diameter class, North Dakota BIA, 1994*

Table 9a.—*Net volume of sawtimber on timberland by species group and diameter class, South Dakota BIA, 1996*

Table 10.—*Net volume of sawtimber on timberland by species group and grade, North Dakota BIA, 1994*

Table 10a.—*Net volume of sawtimber on timberland by species group and grade, South Dakota BIA, 1996*

Table 11.—*Average annual net growth of growing stock and sawtimber on timberland by Forest Survey Unit and major species group, North and South Dakota BIA, 1980-1993*

Table 12.—*Average annual removals of growing stock and sawtimber on timberland by Forest Survey Unit and major species group, North and South Dakota BIA, 1980-1993*

Table 13.—*Average annual net growth and average annual removals of growing stock and sawtimber on timberland by species group, North Dakota BIA, 1980-1993*

Table 13a.—*Average annual net growth and average annual removals of growing stock and sawtimber on timberland by species group, South Dakota BIA, 1980-1993*

Table 14.—*Average annual mortality of growing stock and sawtimber on timberland by species group, North Dakota BIA, 1980-1993*

Table 14a.—*Average annual mortality of growing stock and sawtimber on timberland by species group, South Dakota BIA, 1980-1993*

Table 15.—*Average annual net growth and average annual removals of growing stock and sawtimber on timberland by forest type group/local type and major species group, North Dakota BIA, 1980-1993*

Table 15a.—*Average annual net growth and average annual removals of growing stock and sawtimber on timberland by forest type group/local type and major species group, South Dakota BIA, 1980-1993*

Table 16.—*All live aboveground tree biomass on timberland by major species group, and tree biomass component, North and South Dakota BIA, 1994 and 1996*

Table 17.—*Sampling errors for Forest Survey Unit totals for area of timberland, volume, average annual net growth, and average annual removals on timberland, North and South Dakota BIA, 1994 and 1996*

TABLES

Table 1.--*Area of land by major land-use class, North and South Dakota, BIA lands, 1994 and 1996*

(In thousand acres)

Forest Survey Unit	Total [1] land area	Forest land			Nonforest with trees	Other [2] land
		Total forest	Timberland	Woodland		
North Dakota BIA lands	56.6	47.6	38.8	8.8	4.8	4.2
South Dakota BIA lands	165.4	98.5	92.5	6.0	52.1	14.7
BIA total	222.0	146.1	131.3	14.8	56.9	18.9

[1] *From U. S. Bureau of the Census. 1990 .*

[2] *Includes 400 acres of water according to FIA standards of area classification. but defined by the Bureau of the Census as la*

Table 2.--*Area of timberland by forest type group/local type and stand-size class, North Dakota BIA, 1994*

(In thousand acres)

Forest type group/ local type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling-Seedling	Non-stocked
Ponderosa pine					
Ponderosa pine	--	--	--	--	--
Total	--	--	--	--	--
Rocky Mountain juniper					
Rocky Mountain juniper	--	--	--	--	--
Total	--	--	--	--	--
Oak-hickory					
Bur oak	12.8	4.0	4.6	4.2	--
Total	12.8	4.0	4.6	4.2	--
Elm-ash-cottonwood					
Cottonwood	--	--	--	--	--
Elm-ash-cottonwood	--	--	--	--	--
Willow	--	--	--	--	--
Total	--	--	--	--	--
Maple-beech-birch					
Basswood	--	--	--	--	--
Total	--	--	--	--	--
Aspen-birch					
Aspen-birch	22.4	1.7	13.4	7.3	--
Total	22.4	1.7	13.4	7.3	--
Elm-ash-locust					
Elm-ash	3.6	1.5	--	2.1	--
Total	3.6	1.5	--	2.1	--
Nonstocked	--	--	--	--	--
All types	38.8	7.2	18.0	13.6	--

Table 2a.--*Area of timberland by forest type group/local type and stand-size class, South Dakota BIA, 1996*

(In thousand acres)

Forest type group/ local type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling-Seedling	Non-stocked
Ponderosa pine					
Ponderosa pine	41.3	19.9	9.3	12.1	--
Total	41.3	19.9	9.3	12.1	--
Rocky Mountain juniper					
Rocky Mountain juniper	1.4	--	--	1.4	--
Total	1.4	--	--	1.4	--
Oak-hickory					
Bur oak	21.2	1.6	6.5	13.1	--
Total	21.2	1.6	6.5	13.1	--
Elm-ash-cottonwood					
Cottonwood	6.7	4.2	2.5	--	--
Elm-ash-cottonwood	2.4	0.6	0.9	0.9	--
Willow	2.1	2.1	--	--	--
Total	11.2	6.9	3.4	0.9	--
Maple-beech-birch					
Basswood	3.9	2.2	1.7	--	--
Total	3.9	2.2	1.7	--	--
Aspen-birch					
Aspen-birch	--	--	--	--	--
Total	--	--	--	--	--
Elm-ash-locust					
Elm-ash	12.8	3.7	2.6	6.5	--
Total	12.8	3.7	2.6	6.5	--
Nonstocked	0.7	--	--	--	0.7
All types	92.5	34.3	23.5	34.0	0.7

Table 3.--*Area of timberland by Forest Survey Unit and potential productivity class, North and South Dakota BIA, 1994 and 1996*

(In thousand acres)

Forest Survey Unit	All classes	Potential productivity class		
		85+	50-84	20-49
North Dakota BIA lands	38.8	1.5	14.5	22.8
South Dakota BIA lands	92.5	0.2	12.5	79.8
BIA total	131.3	1.7	27	102.6

Table 4.--*Area of timberland by stocking class of growing-stock trees* [1] *, North and South Dakota BIA, 1994 and 1996*

(In thousand acres)

Forest Survey Unit	All classes	Stocking class of growing-stock trees				
		Non-stocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
North Dakota BIA lands	38.8	2.5	12.9	11.8	11.6	--
South Dakota BIA lands	92.5	8.8	60.3	18.9	4.5	--
BIA total	131.3	11.3	73.2	30.7	16.1	--

[1] *This table is based on the stocking percent of growing-stock trees, rather than that of "live" trees. For this table, to use the definition of stocking found in the appendix, replace the term "live trees" with "growing-stock trees."*

Table 5.--*Number of all live trees on timberland by species group and diameter class, North Dakota BIA, 1994*

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height)											
		1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Hardwoods													
Bur oak	3,505	1,609	746	452	277	205	110	80	15	8	3	--	--
Basswood	63	51	--	--	--	--	--	--	6	6	--	--	--
Elm	681	345	123	189	--	11	4	4	1	--	--	4	--
Green ash	4,290	2,835	957	263	129	90	--	15	--	--	--	1	--
Cottonwood	51	51	--	--	--	--	--	--	--	--	--	--	--
Balsam poplar	963	357	159	127	151	95	49	20	5	--	--	--	--
Quaking aspen	8,577	4,197	1,698	1,275	648	413	275	57	12	--	2	--	--
Paper birch	129	102	--	--	17	--	10	--	--	--	--	--	--
Other hardwoods	747	612	--	41	38	--	10	20	10	4	12	--	--
Total hardwoods	19,006	10,159	3,683	2,347	1,260	814	458	196	49	18	17	5	--
Noncommercial species	3,052	2,913	131	--	--	--	--	--	--	--	--	8	--
All species	22,058	13,072	3,814	2,347	1,260	814	458	196	49	18	17	13	--

Table 5a.--*Number of all live trees on timberland by species group and diameter class, South Dakota BIA, 1996*

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height)											
		1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods													
Ponderosa pine	11,791	4,195	2,740	1,524	1,249	995	459	252	174	113	56	34	--
Other softwoods	1,709	1,182	398	88	3	29	--	7	1	--	--	1	--
Total softwoods	13,500	5,377	3,138	1,612	1,252	1,024	459	259	175	113	56	35	--
Hardwoods													
Bur oak	3,028	166	1,047	850	522	244	100	44	23	12	6	6	8
Basswood	632	153	51	108	60	111	103	18	9	19	--	--	--
Elm	1,933	1,204	377	95	154	32	35	25	8	--	1	2	--
Green ash	3,316	1,291	903	549	316	144	74	14	18	5	--	2	--
Cottonwood	474	51	--	169	82	--	18	20	31	9	--	66	28
Willow	154	51	--	39	16	--	17	31	--	--	--	--	--
Hackberry	55	12	12	--	29	--	2	--	--	--	--	--	--
Black cherry	1	--	--	--	--	--	--	--	--	--	--	1	--
Other hardwoods	1,103	424	236	214	124	21	51	24	4	5	--	--	--
Total hardwoods	10,696	3,352	2,626	2,024	1,303	552	400	176	93	50	7	77	36
Noncommercial species	3,456	3,040	338	47	--	6	11	7	3	1	2	1	--
All species	27,652	11,769	6,102	3,683	2,555	1,582	870	442	271	164	65	113	36

Table 6.--*Net volume of growing stock on timberland by species group and diameter class, North Dakota BIA, 1994*

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Hardwoods											
Bur oak	3,792	627	773	993	835	326	110	--	128	--	--
Basswood	163	--	--	--	--	--	163	--	--	--	--
Elm	587	239	--	--	--	--	--	--	--	348	--
Green ash	982	369	180	274	--	159	--	--	--	--	--
Balsam poplar	3,171	298	713	947	651	411	151	--	--	--	--
Quaking aspen	11,874	2,613	2,911	3,024	2,545	713	68	--	--	--	--
Other hardwoods [1]	442	79	107	--	122	134	--	--	--	--	--
Total hardwoods	21,011	4,225	4,684	5,238	4,153	1,743	492	--	128	348	--
All species	21,011	4,225	4,684	5,238	4,153	1,743	492	--	128	348	--

[1] *All other hardwood growing-stock volume is boxelder.*

Table 6a.--*Net volume of growing stock on timberland by species group and diameter class, South Dakota BIA, 1996*

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Ponderosa pine	33,801	2,384	4,023	6,346	4,662	4,247	4,066	3,647	2,462	1,964	--
Other softwoods	23	23	--	--	--	--	--	--	--	--	--
Total softwoods	33,824	2,407	4,023	6,346	4,662	4,247	4,066	3,647	2,462	1,964	--
Hardwoods											
Bur oak	4,807	744	1,302	1,239	583	155	177	34	127	160	287
Basswood	3,053	161	129	491	955	107	116	365	--	365	365
Elm	1,429	76	533	92	358	370	--	--	--	--	--
Green ash	2,652	434	665	553	156	211	282	117	--	117	117
Cottonwood	15,843	1,652	2,089	--	1,346	1,756	2,983	2,006	--	2,006	2,006
Willow	274	60	--	--	100	114	--	--	--	--	--
Hackberry	72	--	50	--	22	--	--	--	--	--	--
Black cherry	91	91	--	--	--	--	--	--	--	--	--
Other hardwoods [1]	649	199	321	18	111	--	--	--	--	--	--
Total hardwoods	28,870	3,417	5,089	2,393	3,631	2,713	3,558	2,522	127	2,648	2,775
All species	62,694	5,824	9,112	8,739	8,293	6,960	7,624	6,169	2,589	4,612	2,775

[1] *All other hardwood growing-stock volume is boxelder.*

Table 7.--*Net volume of growing stock and sawtimber on timberland by major species group, North and South Dakota BIA, 1994 and 1996*

Forest Survey Unit	Growing stock				
		Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand cubic feet)				
North Dakota BIA	21,011	--	--	16,237	4,774
South Dakota BIA	62,694	33,801	23	21,411	7,459
BIA total	83,705	33,801	23	37,648	12,233

Forest Survey Unit	Sawtimber				
		Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand board feet) [1]				
North Dakota BIA	30,068	--	--	23,375	6,693
South Dakota BIA	234,494	135,048	--	86,528	12,918
BIA total	264,562	135,048	--	109,903	19,611

[1] *International 1/4-inch rule.*

Table 8.--*Net volume of growing stock on timberland by species group and local forest type, North Dakota BIA, 1994*

(In thousand cubic feet)

Species group	All types	Local forest type							
		Ponderosa pine	Rocky Mountain juniper	Bur oak	Cottonwood	Elm-ash-cottonwood	Basswood	Aspen-birch	Elm-ash
Hardwoods									
Bur oak	3,792	--	--	3,339	--	--	--	453	--
Basswood	163	--	--	163	--	--	--	--	--
Elm	587	--	--	--	--	379	--	208	--
Green ash	982	--	--	497	--	116	--	369	--
Balsam poplar	3,171	--	--	462	--	--	--	2,709	--
Quaking aspen	11,874	--	--	434	--	--	--	11,440	--
Other hardwoods [1]	442	--	--	--	--	442	--	--	--
Total hardwoods	21,011	--	--	4,895	--	937	--	15,179	--
All species	21,011	--	--	4,895	--	937	--	15,179	--

[1] *All other hardwood volume is boxelder.*

Table 8a.--*Net volume of growing stock on timberland by species group and local forest type, South Dakota BIA, 1996*

(In thousand cubic feet)

Species group	All types	Local forest type							
		Ponderosa pine	Rocky Mountain juniper	Bur oak	Cottonwood	Willow	Elm-ash-cottonwood	Basswood	Elm-ash
Softwoods									
Ponderosa pine	33,801	27,260	664	5,577	--	--	--	--	300
Other softwoods	23	9	14	--	--	--	--	--	--
Total softwoods	33,824	27,269	678	5,577	--	--	--	--	300
Hardwoods									
Bur oak	4,807	127	--	3,041	--	--	35	101	1,503
Basswood	3,053	--	--	--	--	--	--	2,748	305
Elm	1,429	--	--	368	--	39	14	173	835
Green ash	2,652	109	--	545	138	--	400	473	987
Cottonwood	15,843	--	--	--	7,499	--	1,121	--	7,223
Willow	274	--	--	--	--	274	--	--	--
Hackberry	72	--	--	22	--	--	--	--	50
Black cherry	91	--	--	--	--	--	91	--	--
Other hardwoods [1]	649	--	--	--	--	--	35	111	503
Total hardwoods	28,870	236	--	3,976	7,637	313	1,696	3,606	11,406
All species	62,694	27,505	678	9,553	7,637	313	1,696	3,606	11,706

[1] *All other hardwood volume is boxelder.*

Table 9.--*Net volume of sawtimber on timberland by species group and diameter class, North Dakota BIA, 1994*

(In thousand board feet) [1]

Species group	All classes	Diameter class (inches at breast height)						
		11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Hardwoods								
Bur oak	5,978	3,405	1,443	515	--	615	--	--
Basswood	788	--	--	788	--	--	--	--
Elm	1,716	--	--	--	--	--	1,716	--
Green ash	715	--	715	--	--	--	--	--
Balsam poplar	5,347	2,788	1,845	714	--	--	--	--
Quaking aspen	14,445	10,849	3,276	320	--	--	--	--
Other hardwoods [2]	1,079	483	596	--	--	--	--	--
Total hardwoods	30,068	17,525	7,875	2,337	--	615	1,716	--
All species	30,068	17,525	7,875	2,337	--	615	1,716	--

[1] *International 1/4-inch rule.*

[2] *All other hardwood volume is boxelder.*

Table 9a.--*Net volume of sawtimber on timberland by species group and diameter class, South Dakota BIA, 1996*

(In thousand board feet) [1]

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Ponderosa pine	135,048	29,264	22,362	20,967	20,628	18,740	12,726	10,361	--
Total softwoods	135,048	29,264	22,362	20,967	20,628	18,740	12,726	10,361	--
Hardwoods									
Bur oak	8,961	--	2,550	690	791	151	574	333	3,872
Basswood	10,597	--	6,467	740	814	2,576	--	--	--
Elm	3,162	--	1,513	1,649	--	--	--	--	--
Green ash	3,957	--	690	982	1,375	593	--	317	--
Cottonwood	70,956	--	1,114	1,559	2,724	1,862	--	25,448	38,249
Willow	774	--	353	421	--	--	--	--	--
Hackberry	99	--	99	--	--	--	--	--	--
Black cherry	485	--	--	--	--	--	--	485	--
Other hardwoods [2]	455	--	455	--	--	--	--	--	--
Total hardwoods	99,446	--	13,241	6,041	5,704	5,182	574	26,583	42,121
All species	234,494	29,264	35,603	27,008	26,332	23,922	13,300	36,944	42,121

[1] *International 1/4-inch rule.*

[2] *All other hardwood volume is boxelder.*

Table 10.--*Net volume of sawtimber on timberland by species group and grade, North Dakota BIA, 1994*

(In thousand board feet) [1]

Species group	Total	Tree grade			
		1	2	3	Tie & timber
Hardwoods					
Bur oak	5,978	--	449	962	4,567
Basswood	788	788	--	--	--
Elm	1,716	1,716	--	--	--
Green ash	715	--	--	715	--
Balsam poplar	5,347	--	1,296	1,116	2,935
Quaking aspen	14,445	--	680	10,109	3,656
Other hardwoods [2]	1,079	--	--	--	1,079
Total hardwoods	30,068	2,504	2,425	12,902	12,237
All species	30,068	2,504	2,425	12,902	12,237

[1] *International 1/4-inch rule.*

[2] *All other hardwood volume is boxelder.*

Table 10a.--*Net volume of sawtimber on timberland by species group and grade, South Dakota BIA, 1996*

(In thousand board feet) [1]

Species group	Total	Log grade 1	2	3	4
Softwoods					
Ponderosa pine	135,048	418	5,485	129,144	--
Total softwoods	135,048	418	5,485	129,144	--

Species group	Total	Tree grade 1	2	3	Tie & timber
Hardwoods					
Bur oak	8,961	--	4836	309	3,816
Basswood	10,597	--	3,765	6,832	--
Elm	3,162	--	--	3,162	--
Green ash	3,957	--	--	2,741	1,216
Cottonwood	70,956	43,858	8,142	15,167	3,789
Willow	774	--	--	353	421
Hackberry	99	--	--	99	--
Black cherry	485	--	--	485	--
Other hardwoods [2]	455	--	--	--	455
Total hardwoods	99,446	43,858	16,743	29,148	9,697
All species	234,494	44,276	22,228	158,292	9,697

[1] *International 1/4-inch rule.*

[2] *All other hardwood volume is boxelder.*

Table 11.--*Average annual net growth of growing stock and sawtimber on timberland by Forest Survey Unit and major species group, North and South Dakota BIA, 1980-1993*

Forest Survey Unit	Growing stock				
		Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
		(In thousand cubic feet)			
North Dakota BIA lands	684	--	--	548	136
South Dakota BIA lands	975	559	10	148	258
BIA total	1,659	559	10	696	394

Forest Survey Unit	Sawtimber				
		Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
		(In thousand board feet) [1]			
North Dakota BIA lands	850	--	--	649	201
South Dakota BIA lands	3,037	2,375	3	256	403
BIA total	3,887	2,375	3	905	604

[1] *International 1/4-inch rule .*

Table 12.--*Average annual removals of growing stock and sawtimber on timberland by Forest Survey Unit and major species group, North and South Dakota BIA, 1980-1993*

Forest Survey Unit	Growing stock				
		Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
			(In thousand cubic feet)		
North Dakota BIA lands	54	--	--	37	17
South Dakota BIA lands	89	5	1	44	39
BIA total	143	5	1	81	56

Forest Survey Unit	Sawtimber				
		Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
			(In thousand board feet) [1]		
North Dakota BIA lands	--	--	--	--	--
South Dakota BIA lands	256	--	4	198	54
BIA total	256	--	4	198	54

[1] *International 1/4-inch rule*

Table 13.--*Average annual net growth and average annual removals of growing stock and sawtimber on timberland by species group, North Dakota BIA, 1980-1993*

Species group	Growing stock		Sawtimber	
	Average annual net growth	Average annual removals	Average annual net growth	Average annual removals
	(In thousand cubic feet)		*(In thousand board feet)* [1]	
Hardwoods				
Bur oak	81	--	195	--
Basswood	--	--	3	--
Elm	-2	--	-203	--
Green ash	55	17	6	--
Balsam poplar	74	--	273	--
Quaking aspen	457	37	535	--
Other hardwoods [2]	19	--	41	--
Total hardwoods	684	54	850	--
All species	684	54	850	--

[1] *International 1/4-inch rule.*

[2] *All other hardwood volume is boxelder.*

Table 13a.--*Average annual net growth and average annual removals of growing stock and sawtimber on timberland by species group, South Dakota BIA, 1980-1993*

Species group	Growing stock		Sawtimber	
	Average annual net growth	Average annual removals	Average annual net growth	Average annual removals
	(In thousand cubic feet)		*(In thousand board feet)* [1]	
Softwoods				
Ponderosa pine	559	5	2,375	--
Other softwoods	10	1	3	4
Total softwoods	569	6	2,378	4
Hardwoods				
Bur oak	157	2	107	10
Basswood	68	3	290	15
Elm	5	30	-111	138
Green ash	101	37	296	44
Cottonwood	50	--	-13	--
Willow	17	--	41	--
Hackberry	4	--	4	--
Black cherry	1	--	--	--
Other hardwoods [2]	3	11	45	45
Total hardwoods	406	83	659	252
All species	975	89	3,037	256

[1] *International 1/4-inch rule.*

[2] *All other hardwood volume is boxelder.*

Table 14.--*Average annual mortality of growing stock and sawtimber on timberland by species group, North Dakota BIA, 1980-1993*

Species group	Growing stock average annual mortality	Sawtimber average annual mortality
	(In thousand cubic feet)	*(In thousand board feet)* [1]
Bur oak	--	--
Basswood	--	--
Elm	49	217
Green ash	2	--
Balsam poplar	77	107
Quaking aspen	277	383
Other hardwoods [2]	6	14
All species	411	721

[1] *International 1/4-inch rule.*

[2] *All other hardwood volume is boxelder.*

Table 14a.--*Average annual mortality of growing stock and sawtimber on timberland by species group, South Dakota BIA, 1980-1993*

Species group	Growing stock average annual mortality *(In thousand cubic feet)*	Sawtimber average annual mortality *(In thousand board feet)* [1]
Softwoods		
Ponderosa pine	204	925
Total softwoods	204	925
Hardwoods		
Bur oak	11	53
Basswood	47	111
Elm	99	296
Green ash	52	50
Cottonwood	300	1,254
Willow	7	23
Hackberry	1	1
Other hardwoods [2]	28	8
Total hardwoods	545	1,796
All species	749	2,721

[1] *International 1/4-inch rule.*

[2] *All other hardwood volume is boxelder.*

Table 15.--*Average annual net growth and average annual removals of growing stock and sawtimber on timberland by forest type group/local type and major species group, North Dakota BIA, 1980-1993*

Forest type group/ local type	Average annual net growth of growing stock					Average annual removals of growing stock				
	All species	Major species group				All species	Major species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand cubic feet)					*(In thousand cubic feet)*				
Oak-hickory										
Bur oak	86	--	--	7	79	--	--	--	--	--
Total	86	--	--	7	79					
Aspen-birch										
Aspen-birch	592	--	--	551	41	54	--	--	37	17
Total	592	--	--	551	41	54	--	--	37	17
Elm-ash-locust										
Elm-ash	6	--	--	-10	16	--	--	--	--	--
Total	6	--	--	-10	16	--	--	--		
All forest types	684	--	--	548	136	54	--	--	37	17

Forest type group/ local type	Average annual net growth of sawtimber					Average annual removals of sawtimber				
	All species	Major species group				All species	Major species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand board feet) [1]					*(In thousand board feet)* [1]				
Oak-hickory										
Bur oak	129	--	--	-72	201	--	--	--	--	--
Total	129	--	--	-72	201	--	--	--	--	--
Aspen-birch										
Aspen-birch	833	--	--	833	--	--	--	--	--	--
Total	883	--	--	833	--	--	--	--	--	--
Elm-ash-locust										
Elm-ash	-112	--	--	-112	--	--	--	--	--	--
Total	-112	--	--	-112	--	--	--	--	--	--
All forest types	850	--	--	649	201	--	--	--	--	--

[1] *International 1/4-inch rule.*

Table 15a.--*Average annual net growth and average annual removals of growing stock and sawtimber on timberland by forest type group/local type and major species group, South Dakota BIA, 1980-1993*

Forest type group/ local type	Average annual net growth of growing stock					Average annual removals of growing stock				
	All species	Major species group				All species	Major species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand cubic feet)					(In thousand cubic feet)				
Ponderosa pine										
Ponderosa pine	452	432	8	-5	17	5	5	--	--	--
Total	452	432	8	-5	17	5	5	--	--	--
Rocky Mountain juniper										
Rocky Mountain juniper	18	14	2	1	1	1	--	1	--	--
Total	18	14	2	1	1	1	--	1	--	--
Oak-hickory										
Bur oak	282	98	--	17	167	--	--	--	--	--
Total	282	98	--	17	167	--	--	--	--	--
Elm-ash-cottonwood										
Cottonwood	153	--	--	148	5	--	--	--	--	--
Willow	18	--	--	18	--	--				
Elm-ash-cottonwood	41	--	--	30	11	66	--	--	41	25
Total	212	--	--	196	16	66	--	--	41	25
Maple-beech-birch										
Basswood	76	--	--	67	9	--	--	--	--	--
Total	76	--	--	67	9	--	--	--	--	--
Elm-ash-locust										
Elm-ash	-65	15	--	-128	48	17	-	-	3	14
Total	-65	15	--	-128	48	17	-	-	3	14
All forest types	975	559	10	148	258	89	5	1	44	39

Forest type group/ local type	Average annual net growth of sawtimber					Average annual removals of sawtimber				
	All species	Major species group				All species	Major species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand board feet) [1]					(In thousand board feet) [1]				
Ponderosa pine										
Ponderosa pine	1,825	1,845	--	-20	--	--	--	--	--	--
Total	1,825	1,845	--	-20	--	--	--	--	--	--
Rocky Mountain juniper										
Rocky Mountain juniper	157	152	3	2	--	4	--	4	--	--
Total	157	152	3	2	--	4	--	4	--	--
Oak-hickory										
Bur oak	401	318	--	1	82	--	--	--	--	--
Total	401	318	--	1	82	--	--	--	--	--
Elm-ash-cottonwood										
Cottonwood	494	--	--	494	--	--	--	--	--	--
Willow	41	--	--	41	--	--	--	--	--	--
Elm-ash-cottonwood	102	--	--	109	-7	183	--	--	183	--
Total	637	--	--	644	-7	183	--	--	183	--
Maple-beech-birch										
Basswood	244	--	--	228	16	--	--	--	--	--
Total	244	--	--	228	16	--	--	--	--	--
Elm-ash-locust										
Elm-ash	-227	60	--	-599	312	69	--	--	15	54
Total	-227	60	--	-599	312	69	--	--	15	54
All forest types	3,037	2,375	3	256	403	256	--	4	198	54

[1] *International 1/4-inch rule.*

Table 16.--*All live aboveground tree biomass on timberland by major species group, and tree biomass component, North and South Dakota BIA, 1994 and 1996*

(In green tons)

Ownership class and major species group	All Components	Tree biomass component						
		All 1-5 inch trees	Growing-stock trees			Non-growing-stock trees		
			Stumps	Boles	Tops and limbs	Stumps	Boles	Tops and limbs
North Dakota BIA lands								
Soft hardwoods	1,184,331	125,441	37,358	510,571	147,830	19,342	272,264	71,525
Hard hardwoods	604,996	97,054	18,757	168,187	59,546	18,851	182,363	60,238
Total	1,789,327	222,495	56,115	678,758	207,376	38,193	454,627	131,763
South Dakota BIA lands								
Pine	1,208,717	75,072	77,014	868,815	97,040	7,562	74,397	8,817
Other softwoods	35,294	14,135	113	580	227	1,801	14,448	3,990
Soft hardwoods	1,195,385	54,679	48,955	625,640	149,706	21,291	228,378	66,736
Hard hardwoods	952,988	93,139	26,552	247,183	82,394	37,074	350,545	116,101
Total	3,392,384	237,025	152,634	1,742,218	329,367	67,728	667,768	195,644

Table 17.--*Sampling errors for Forest Survey Unit totals for area of timberland, volume, average annual net growth, and average annual removals on timberland, North and South Dakota BIA, 1994, and 1996*

(Sampling error in percent)

Forest Survey Unit	Area	Growing stock			Sawtimber		
		Volume	Average annual net growth	Average annual removals	Volume	Average annual net growth	Average annual removals
North Dakota BIA	14.8	24.6	28.3	136.6	38.9	57.4	--
South Dakota BIA	6.7	7.8	16.9	70.6	12.4	23.0	69.0
BIA total	6.4	8.5	15.0	67.8	11.9	21.9	69.0

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410, or call (202) 720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

Printed on recyclable paper

MISSION STATEMENT

We believe the good life has its roots in clean air, sparkling water, rich soil, healthy economies and a diverse living landscape. Maintaining the good life for generations to come begins with everyday choices about natural resources. The North Central Research Station provides the knowledge and the tools to help people make informed choices. That's how the science we do enhances the quality of people's lives.

For further information contact:

North Central Research Station
USDA Forest Service
1992 Folwell Ave.
St. Paul, MN 55108

Or visit our web site:

www.ncrs.fs.fed.us

The Forest Inventory and Analysis web site is:
www.fia.fs.fed.us

☆U.S. GOVERNMENT PRINTING OFFICE: 2002-757-170

Haugen, David E.; Hansen, Mark H.

2002. **BIA forest lands of North and South Dakota, 1996.** Resour. Bull. NC-202. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 56 p.

An estimated 146 thousand acres of forest land are under BIA jurisdiction, and 131 thousand acres of that are forest land and timberland. This bulletin contains detailed tables of area, volume, growth, removals, and mortality on timberland.

KEY WORDS: Forest area, timber volume, growth, removals, mortality, BIA.